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Research Overview and Proposed Budget 1993 – 1994

Technology and Research Advisory Committee

Summary and analyses of the proposed 1993/94 Alberta Government research and technology program and budget

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Summary and analysis of the proposed 1993/94 Alberta Government research and technology program and budget

December 1992

A study conducted by the Technology and Research Advisory Committee for the Minister of Technology, Research and Telecommunications

and

the Deputy Ministers Committee on Research and Development Policy and Priorities

Contents

1. Preface 1
2. Executive Summary 2
3. Recommendations 3
4. Highlights of 1993-94 Research Plans 5
5. Recommendations from 1992/93 Research Overview 6
6. Introduction 10
7. Findings 11
8. 1993/94 Research Programs — by Department and Agency 17
   - 8.1 Alberta Advanced Education 17
   - 8.2 Alberta Family Life and Substance Abuse Foundation 20
   - 8.3 Alberta Agriculture 22
   - 8.4 The Alberta Agricultural Research Institute 31
   - 8.5 Alberta Heritage Foundation for Medical Research (AHFMR) 40
   - 8.6 Alberta Oil Sands Technology and Research Authority 43
   - 8.7 Alberta Research Council 48
   - 8.8 Alberta Culture and Multiculturalism 55
   - 8.9 Alberta Economic Development and Trade 58
   - 8.10 Alberta Energy 61
   - 8.11 Alberta Environment 69
   - 8.12 Alberta Forestry, Lands and Wildlife 81
   - 8.13 Alberta Health 85
   - 8.14 Alberta Occupational Health and Safety (AOHS) 90
   - 8.15 Alberta Technology, Research and Telecommunications (TRT) 93
   - 8.16 Alberta Transportation and Utilities 98

Appendix 1 — Participants in The Research Overview Study 104

Appendix 2 — Progress on Implementation of Recommendations of Research Co-ordination Report 105

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1. Preface

Science and technology are essential components of the activities of the Government of Alberta. The involvement of government in the research process is imperative if the longer term goals of society are to be met. Federal government, industry and the universities also participate in the funding and performing of scientific research and development in Alberta. Industrial research often does not extend beyond the interest of specific companies. University research on the other hand is often determined by the intellectual curiosity of the researcher. It is focused on the advancement of knowledge and the training of graduate students. Government *performed* research takes the middle ground between these two "extremes." It is generally applied research directed towards achieving the strategic goals of individual departments and agencies. Government also *funds* research in industry and universities in furtherance of these same goals.

All three research activities are vital. The applied research performed by industry and the targeted research funded and performed by government often depend on the base of knowledge developed by the university research.

This report describes the Alberta Government research investment in the major "funding" and "performing" departments and agencies. It also highlights some of the past achievements and expected impact of these investments.

It is clear that new policy decisions are required to ensure that Alberta is able to meet the technology intensive global competition of the 1990s and beyond. The complexity of these technology and economic challenges requires more highly integrated and longer term planning than has occurred in the past. Departments and agencies require more flexibility in the management of their resources to enable them to maximize their efforts. They must be encouraged to share resources and to network both within the government structure and with the Federal government, industry and universities. To do these effectively will require modification of existing administration and budgetary procedures.

2. Executive Summary

This report presents an overview and analysis of the total Alberta Government 1993-94 proposed research program and budget prior to the budget review cycle. The 1993-94 research programs for 16 departments and agencies are presented with examples of accomplishments and impacts on the economic and social development of the province.

1. The Alberta Government investment in science and technology (S&T) activities, which includes research and development (R&D) and related scientific activities (RSA), in 1982 dollars has decreased at almost a uniform rate from $256 million in 1984 to $155 million in 1992.

2. The proposed S&T investment for 1993-94 is $241.31 million (in 1992 dollars), an increase of approximately 5% from 1992-93. The proposed R&D investment of $143.65 million is also an increase of about 5% from 1992-93, but falls far short of the 15% annual increase required by each of the provincial and federal governments and industry if R&D investment in Alberta is to achieve a level of 2.5% of GDP in the next decade. To bring the industry and federal investment up to the level of the leaders in Canada (Ontario and Quebec) and the world (Japan, Germany etc.), a long term science and technology plan and strategy must be developed for the province.

3. When government departments and agencies invest in joint S&T activities with industry, they have been successful in negotiating additional investment from industry and the federal government at leverage of three to one and higher. Government funds are also leveraged in funding university research. The level is more difficult to document but it is estimated that it also is approximately two to three times the government investment.

4. The departments and agencies of the Alberta Government, in carrying out their S&T plans, need improved recapitalization, human resource development strategies and a greater flexibility in managing their funds to achieve their plans.

3. Recommendations

The following recommendations are in addition to those presented previously in the 1992/93 Research Overview.

Recommendation 1

The Alberta Government should develop a long term science and technology (S&T) plan with strategies for implementation which clearly establish the priorities for its departments and agencies.

1.1 The S&T plan developed with input from industry, the health sector, relevant community groups and the Premier's Council on Science and Technology must be an integral part of the economic and social plan of the Province and connected to Toward 2000 Together.

1.2 Within the context of a provincial S&T plan, an implementation strategy should be developed to guide appropriately balanced investments in basic research, applied research and technology development and training.

1.3 Within the context of a provincial S&T plan an implementation strategy should be developed for the dual technology focus which was set out as recommendation 1.3 of the 1992/93 Research Overview.

Recommendation 2

Each Alberta department and agency should develop long-term R&D plans with long and short term strategies for implementation and including the expected impact of the activities. Approvals for these plans should be sought through Request for Decision (RFD).

2.1 An ongoing review of all government R&D programs should be undertaken including an analysis of how effective the research funding has been including a statement of the economic and social impact and the changes that can be made to improve effectiveness.

2.2 All new research and development programs should contain an economic, environmental and social benefit/impact statement. Each program, grant etc., should indicate how and who will implement the science or technology which will be developed.

2.3 The budget of multi-year programs should be committed for the term of a program to allow departments and agencies to have more flexibility to develop co-operative research ventures with other organizations, and better plan and manage their financial, human and capital resources.

Recommendation 3

Departments and agencies which perform and fund research should be given the ability to manage their funds over periods longer than one year by having approved rolling three to five year plans, with the requirement to carry forward surpluses and deficits into the following year.

3.1 Departments and agencies with specialized expertise and equipment needed by others should be given the ability to retain revenue for services provided on a fee-for-service basis.

Recommendation 4

Departments and agencies should develop plans to ensure and maintain a high level of human resource capability and facilities to achieve their mission and goals.

4.1 Departments and agencies should develop plans for appropriate hiring and training practices to ensure their human resources reflect future needs of the organization.

4.2 Departments and agencies which have aging equipment and instrumentation should develop plans for recapitalization to maintain an appropriate balance among investments in manpower, supplies and services and capital.

4. Highlights of 1993-94 Research Plans

Alberta Government departments and agencies are proposing a science and technology budget of $241.31 million for 1993/94. The following highlights illustrate the breadth of this portfolio of programs:

- new programs for treatment of substance abuse
- new varieties of horticulture and specialty crops suitable to the agro-climatic regions of Alberta
- improved livestock nutrition, health, breeding and management procedures
- improved food processing to add value to Alberta-produced commodities
- new treatment of diseases and health problems of Albertans
- new processes to improve the recovery of bitumen and heavy oil from deposits in Alberta
- improved processing of new materials into consumer products
- new displays of archaeological and paleontological discoveries
- improved waste management, waste minimization, and recycling
- improved environmentally acceptable processes for utilizing Alberta coals for power generation
- new environmentally acceptable technologies to harness our renewable energy sources
- new guidelines for safe exposure to hydrogen sulphide
- environmentally friendly biological control of weeds
- more efficient effluent treatment processes of both kraft and chemithermo-mechanical pulping mills
- better yields and products from Alberta sawmills
- improved health care
- reduction of chemical and biological hazards to workers
- development of new wireless technologies for use in telecommunications
- improved roadway planning to provide systematic selection of highway routes, to maximize design benefits at a reduced cost

5. Recommendations from 1992/93 Research Overview

The recommendations in the Research Overview and Proposed 1992/93 Budget are listed below as they continue to be relevant to this report. Some steps have been taken to address the issues identified in these recommendations, however certain aspects will require more attention.

1. As part of the Toward 2000 Together process, the Department of Technology Research and Telecommunications prepared a discussion paper, Science and Technology in the New Alberta Economy, which elicited considerable response from the business community and is being incorporated in the Provincial plan and strategy coming from the Toward 2000 Together process (see recommendation 1 below).

2. In order to achieve the business and economic competitiveness identified by the Toward 2000 Together process, it is important that the level of investment in research and development in the province be brought to the level of the leading countries in the world. Total investment in R&D by industry and the two orders of government now is at 0.9% of gross provincial product. This year the Provincial Government investment dropped almost 10%. To achieve (within the next ten years) a level of 2.5% of GDP, which is the average of the eight leading countries with which we compete in international markets, will require each of the governments and industry to increase their investment 10% to 15% annually (see recommendation 2 below).

3. Increased efforts must be placed on programs to increase industrial commitment and investment in R&D. The co-funded programs are very effective in obtaining industry investment at two to five times the government investment. However more effort must be placed on developing the climate to stimulate industrial investment in both research and development without direct government investment. Tax structures must be examined and adjusted to encourage industry to develop and install new processes and equipment to increase their competitiveness on a world scale (see recommendation 3 below).

   The Department of Technology Research and Telecommunications commissioned an overview of industrial research in the province to evaluate the level of research investment in various sectors and the perceived impediments to research investment by industry (L. Bolger, "Alberta Industry R&D Overview," to be released December 1992).

   Provincial support in various areas will continue to be required, particularly in infrastructure and the developing technology sectors (see recommendation 3.3 below).

Recommendation 1

The Alberta Government should make technology-based industrial competitiveness a major goal for this decade.

1.1 Establish and Maintain a Technology Strategy Focused on Industrial Competitiveness

The Alberta Government will need to devote more attention to research and technology if Alberta wishes to remain a key player in highly competitive and technology-sophisticated world markets. The Alberta Government should make technology competitiveness a major goal in its programs for this decade. Each department and agency should have a well developed technology plan, which is integrated with its overall strategic plan. A comprehensive Government technology strategy should be developed and brought into sharp focus prior to reviewing the budget requests of individual departments and agencies.

The public discussions on "Toward 2000 Together" should help in the preparation of an overall strategic plan for the Province.

1.2 Include the Following Elements in the Technology Strategy

- linking our natural resource/high technology strategies
- emphasizing key emerging technologies as new economic wealth-generators
- balancing short and long term objectives
- supporting infrastructure for key sectors
- preserving our environment
- developing effective working arrangements with the private sector
- expanding interdepartmental collaboration.

1.3 Continue to Support a Dual Technology Strategy, with Improved Linkages

The Alberta Government should maintain its dual strategy of (a) utilizing technology to enhance natural resource development, and (b) stimulating high technology industries. Programs which provide a close linkage between these two thrusts should be supported. Focusing our high technology capability of the technological needs of the resource industries will have a double benefit. It will help ensure survival of the wealth-generating capability of the resource industries and, at the same time, will give high technology companies an opportunity to test and refine their products in the domestic market. Support for the high technology sector will help diversify the economy by connecting Alberta to new product opportunities and rapidly growing world markets.

1.4 Enhance Interdepartmental Co-ordination Through Co-funded, Co-managed Programs

The complexity of today's social and economic issues requires a high level of interdepartmental planning and co-operation. The development of joint programs in areas where there are overlapping mandates is an effective way

of providing cost-effective and unified programs. Research, which provides the direction to the future, is an important area for such interdepartmental collaboration.

Recommendation 2

The Alberta Government should increase and maintain its research investment at $300 million per year.

2.1 Set Our Annual Research Investment at $300 Million, the Investment Needed to Return to Mid-1980 Activity Levels

Our research investments have served us well in the past, and will be crucial in meeting global competition. Investment in science and technology will lead to expansion in our gross domestic product and larger government revenues. The increase in research investment should be in those areas where deficiencies in the application of new technology are impeding the attainment of a globally competitive economy. The areas for immediate examination include:

- high speed telecommunications network
- geographic information systems
- product upgrading in agriculture, energy and forestry
- simulation technology to reduce the cost of direct experimentation in the resource sectors
- health care and occupational health products and practices
- environmental products and practices
- high performance computing/ information technologies
- an appropriate commitment to basic science in areas important to our long term interests
- information technology as basic support to all industry.

2.2 Increase the Emphasis on Environmentally Sound Resource Development

In the future, advanced technology will be required to extract and upgrade natural resources with significantly reduced environmental impacts, and with a higher level of health and safety protection for workers and the general public. The Alberta Government should ensure these aspects are effectively entrenched in its technology plan. Business opportunities arising from the expertise developed in these areas should be captured.

2.3 Expand the Role of TRAC in Recommending Specific Research Programs

The specific programs for enhanced investment should be recommended by the Technology and Research Advisory Committee (TRAC), using the information in the Research Overview Report as major input.

Recommendation 3

The Alberta Government should put top priority on programs to substantially increase the industrial commitment to R&D

3.1 Develop Appropriate Working Arrangements with the Private Sector

Alberta Government Departments and Agencies should develop an appropriate set of working arrangements with the private sector, which reflect the maturity

of the sector involved, and the role of government in that sector. These working relationships should change with time, reflecting the increasing sophistication and capability of the private sector.

3.2 Seek Industrial Support for Co-Funded Programs

Alberta Government departments and agencies should develop plans to stimulate additional research investment by industry, using the enhanced funding in recommendation 2.1 for new co-funded programs.

3.3 Continue to Support Technology Infrastructure Required by Industry

The Alberta Government should continue to support the increased application of new technologies to industry through research infrastructure support, testing facilities, research consortia, technology institutes, advanced education, technology transfer, business counselling and trade promotion. Industries involved in the new technologies are growing at twice the rate of other sectors. If Alberta wishes to participate in this growth, a well-developed network of technology support will be needed by Alberta's small but aggressive private sector participants.

3.4 Publicize Past Research Accomplishments

The Alberta Government should ensure that the high pay-out from past investments in research are known outside the specific sectors involved. The dramatic record of past industrial research accomplishments should be publicized as a stimulus for future investments.

6. Introduction

The first Research Overview Report was prepared in 1991 and dealt with the research budget for 1992-93. Following its submission to the Economic Planning Committee of Cabinet, the Committee requested that a report be prepared on an annual basis as background for the budgetary review process.

The Deputy Ministers' Committee on Research and Policy requested the Technology and Research Advisory Committee (TRAC) to co-ordinate the preparation of this report. A task group of three members of TRAC gathered the data and prepared a preliminary report. The individuals involved in this process are listed in Appendix 1.

The primary objectives of this study are:

- To prepare a description and analysis of the proposed 1993/94 science and technology investments as an aid in Treasury Board review of the 1993/94 budget submissions.
- To identify any concerns and problems the R&D funding and performing departments and agencies are encountering in meeting their objectives and mandates.

This report covers the Research and Development (R&D) and Related Scientific Activities (RSA) of the Alberta Government. It includes the activities in both natural science and engineering areas as well as the humanities and social sciences. It does not attempt to assess the effectiveness of the programs of the individual departments and agencies but does highlight some key accomplishments of these programs. It also provides examples of the impact these programs have on the economic and social well being of the province.

The co-ordination of S&T activities and programs across the provincial government was addressed in the Research Co-ordination Report prepared in 1990. The recommendations stemming from the study were addressed over the past two years. Appendix II provides a listing of each of these recommendations and the progress in addressing these issues.

There has been confusion in the past in the use of the terms "research and development" (R&D) and "related scientific activities" (RSA). Although there are internationally accepted definitions for these activities, their application in specific situations is not at all clear. Particular attention was paid this year to this problem. The interpretation of R&D is reasonably clear. R&D includes all creative work undertaken on a systematic basis in order to increase the stock of scientific and technical knowledge or to discover new applications for existing knowledge. The central characteristic being an appreciable element of novelty.

Related scientific activities (RSA) include those activities which complement and extend R&D by contribution to the generation, dissemination and application of scientific and technological knowledge. Where RSA is performed in support of R&D the interpretation is also fairly clear. Difficulty arises though, where an organization does not perform or fund R&D, but where activities are undertaken which may be considered to be RSA. Hopefully, the information presented will be more consistent with Statistics Canada practice and international convention.

As a result of the increased diligence in applying the definitions for R&D and RSA, there will be some increase in this year's RSA figures relative to last year. There is, however, no major effect on the total S&T budget.

7. Findings

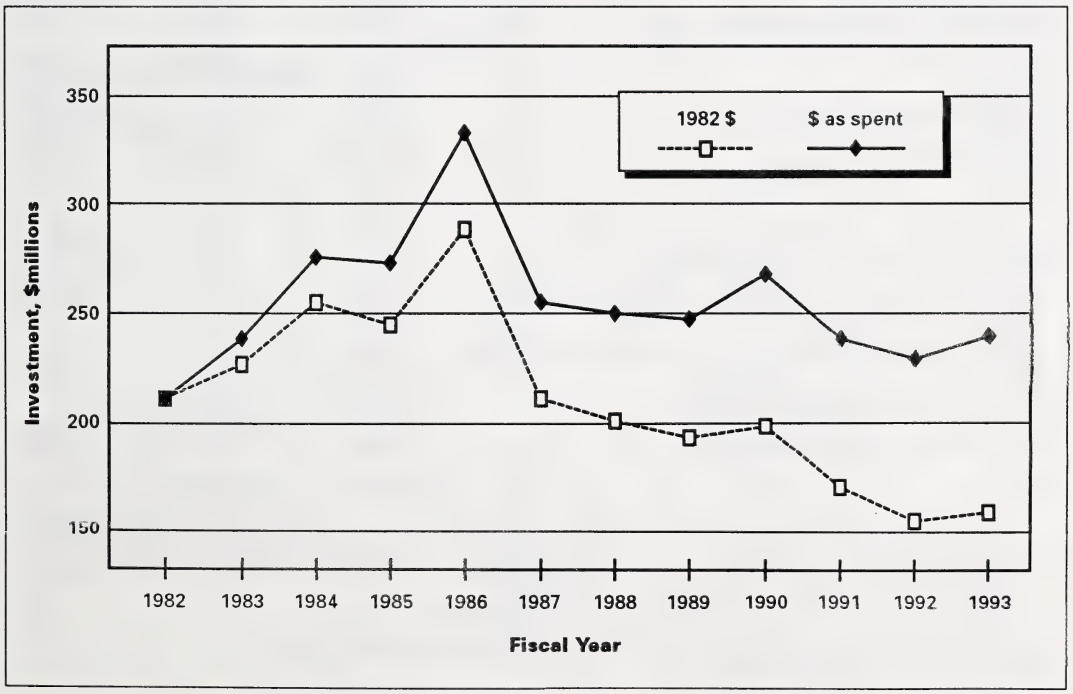
1. Since 1982-83 the investment in research and development (R&D) and related scientific activities (RSA), normally termed S&T, has been $250 to $270 million (except for 1986) dropping to $229.92 million in 1992-93 (Figure 7.1).

   The S&T investment proposed for 1993/94 is $241.13 million (Tables 7.1 & 7.2). There was some increase in R&D indicated in several departments because of new programs such as the Western Economic Partnership Agreements (WEPA) with the federal government and a small increase in RSA as indicated above.

2. Approximately 1970 people are directly employed within the Government to perform and administer the S&T activities. An additional 3000 researchers and students are involved in the research programs supported outside of the departments and agencies through contracts and grants.

3. Alberta universities perform approximately one-third of the provincial government funded R&D through grants and contracts from the departments and agencies. These investments in research are instrumental in attracting a growing

Figure 7.1 Annual Investment in Scientific Activities (R&D and RSA)



R&D investment by federal and international funding agencies and industry in the province. In the past year this has been most evident in the increase in research funding by drug companies.

4. The departments and agencies fund or collaborate in R&D projects with other departments and agencies, industry and federal institutions (Table 7.3) to maximise the effort and return on the projects. Most of these investments generate at least an equal investment from industry and the Government of Canada; often, considerably more.

5. R&D as a percentage of total investment in scientific activities was between 65% and 68% of total investment prior to 1987 as noted in table 7.4. Since 1987 it has dropped about 11%.

Table 7.1 Proposed 1993/94 Scientific Activities Budget ($ Million)

Department/Agency	1991/92 Actual	1992/93 Estimated	1993/94 Proposed
Alberta Agriculture	13.85	13.80	18.00[2]
Alberta Agricultural Research Institute	5.85	5.86	5.85
Alberta Energy	6.34	7.69	9.15[3]
AOSTRA	38.55	20.00	26.13
Alberta Research Council	27.41	27.90	25.63
Alberta Environment	18.74	18.15	22.19[2]
Alberta Forestry, Lands & Wildlife	23.22	24.09[3]	26.26[3]
Alberta Health	5.49	5.91	5.91
Alberta Family Life & Substance Abuse Fund	0.42	5.00	5.00
Alberta Occupational Health & Safety	0.87	1.14	1.03
Alberta Heritage Foundation for Medical Research	27.48	31.26	30.94
Alberta Economic Development & Trade	2.66	2.55	2.60[2]
Alberta Technology, Research & Telecommunications	19.88	17.65	16.40
Alberta Transportation & Utilities	6.86	8.38	8.38
Alberta Culture & Multiculturalism	21.56	20.24	20.24
Other Departments & Agencies	17.60	17.60[4]	17.60[4]
TOTAL	**$238.78**	**$227.22**	**$241.31**[1]

1) Alberta Advanced Education provides vital funding for operational and infrastructure support for R&D at Alberta universities, estimated to be $189 million. Such contributions to infrastructure are not normally included in R&D investment statistics. Alberta universities perform approximately one-third of the provincially funded R&D through grants and contracts from the departments and agencies.

2) Not a real increase but due to re-examination of activities under RSA.

3) Increase primarily the result of the Western Economic Partnership Agreement (WEPA).

4) Estimated from 1991/92 investment.

Table 7.2 Proposed 1993/94 Funding by Economic and Social Sector ($ Million)

	R&D	RSA	TOTAL
Agriculture and Food			
Alberta Agricultural Research Institute	5.14	0.71	5.85
Alberta Agriculture	10.22	7.78	18.00
Alberta Environment	3.15	0.65	3.80
ARC	1.75	–	1.75
Total	20.26	9.14	29.40
Petroleum and Gas			
AOSTRA	23.34	2.06	25.40
ARC	5.44	–	5.44
Total	28.78	2.06	30.84
Coal			
Alberta Energy	1.50	0.35	1.85
ARC	1.11	–	1.11
Total	2.61	0.35	2.96
Other Energy and Mineral			
Environment	0.40	–	0.40
Alberta Energy	4.75	2.55	7.30
ARC	0.43	–	0.43
Total	5.58	2.55	8.13
Forestry			
Environment	0.94	0.51	1.45
AFL&W	2.79	23.47	26.26
ARC	0.43	–	0.43
Total	4.16	23.98	28.14
Health Care and Medical			
Alberta Health	3.76	2.15	5.91
Alberta Environment	0.52	1.73	2.25
Alberta Occupational Health & Safety	0.65	0.38	1.03
AHFMR	30.94	–	30.94
ARC	1.48	–	1.48
ATRT	2.00	–	2.00
AFLSAF	0.50	4.50	5.00
Total	39.85	8.76	48.61

Continued on page 14

Table 7.2 Continued

	R&D	RSA	TOTAL
Manufacturing			
ATRT	6.00	0.60	6.60
AED&T	–	2.60	2.60
ARC	8.98	–	8.98
Total	14.98	3.20	18.18
Transportation			
Alberta Transportation & Utilities	1.89	6.49	8.38
ARC	0.94	–	0.94
Total	2.83	6.49	9.32
Environment			
Alberta Environment	7.65	6.28	13.93
AOSTRA	0.73	–	0.73
ARC	4.11	–	4.11
Total	12.49	6.28	18.77
Infrastructure & Other			
Alberta Culture & Multiculturalism	4.45	15.79	20.24
ATRT	5.05	2.75	7.80
Environment	0.36	–	0.36
ARC	0.96	–	0.96
Other Departments & Agencies[1]	1.29	16.31	17.60
Total	12.11	34.85	46.96
TOTAL	**$143.65**	**$97.66**	**$241.31[2]**

1. Estimated from 1991/92 investment
2. Alberta Advanced Education provides vital funding for operational and infrastructure support for R&D at Alberta universities, estimated to be $189 million. Such contributions to infrastructure are not normally included in R&D investment statistics. Alberta universities perform approximately one-third of the provincially funded R&D through grants and contracts from the departments and agencies.

Table 7.3 1993/94 Estimate of Expenditures by Performers of Research and Development ($Million)

	Alberta Agriculture	AOSTRA	Alberta Culture	Alberta Environment	ARC	Other Government R&D	Universities	Other Research Organizations	Industry	Federal
Funders										
Agriculture	8.23			0.07	0.10		0.78		0.50	0.54
Agricultural Research Institute	0.62			0.18			2.30	0.71	0.12	1.95
ARC					25.63					
AOSTRA		3.70			2.30		1.40	1.24	15.28	0.15
AFLSAF							0.50			
AHFMR							30.94			
Culture			4.45							
Energy					1.39		0.04	0.10	2.87	0.39
Environment				9.83	1.41		0.21		1.03	
FLW					0.42		0.06	0.15	2.23	
Health							2.17		1.31	
Occupational Health & Safety							0.25	0.03	0.08	
TRT							1.40	4.10	7.55	
Transportation					0.30		0.07	0.30	0.10	
Other Departments						4.19				

Alberta Advanced Education provides vital funding for operational and infrastructure support for R&D at Alberta universities, estimated to be $189 million. Such contributions to infrastructure are not normally included in R&D investment statistics. Alberta universities perform approximately one-third of the provincially funded R&D through grants and contracts from the departments and agencies.

Table 7.4 R&D And RSA Investments in Past Ten Years ($ Million)

	R&D	RSA	Total	R&D % Total
93	143.65	97.66	241.31	59.0
92	139.81	89.77	229.58	60.9
91	138.46	100.32	238.78	58.0
90	168.32	99.84	268.16	62.8
89	148.24	99.02	247.26	60.0
88	150.12	98.54	248.66	60.4
87	172.70	81.47	254.17	67.9
86	251.92	81.51	333.43	75.6
85	179.37	93.01	272.38	65.9
84	187.00	89.71	276.71	67.6
83	155.28	83.59	238.87	65.0
82	137.76	75.07	212.83	64.7

6. Inflation has steadily eroded the S&T investment to the point that the research level both in human effort and available research equipment has been substantially decreased. The effect on funding and performing departments and agencies is somewhat different. The end result is that an increasing number of programs border on being sub-critical and may have difficulty in attracting co-operation with other organizations and industry. The opportunity to lever provincial research funds is thereby diminished.

   The funding departments are primarily affected in that they are required to cut down the number of programs they support. The organizations they fund must either reduce their staff levels or find funding elsewhere.

   The performing departments and agencies have tried to maintain their research effort by reducing their expenditures on new research equipment and cutting back on maintenance. This has resulted in a serious situation where equipment purchased in the sixties and seventies is no longer cost effective. Furthermore it often does not produce the scientific information that new instruments provide. Research instruments are generally also used for diagnostic and analytical services and these services are similarly affected by the deterioration.

7. Replacement equipment is expensive and generally well beyond the capital funds available to a department or agency in any one year. These departments and agencies recognize the overall shortage of funds available and desire a greater flexibility to manage the resources available to them. Some departments may require substantial investment to bring their research instrumentation to acceptable levels.

8. The annual budgetary process with commitment of funding for one year at a time limits the planning of longer term research programs and networking. Greater flexibility is required to allow better management of resources available.

9. Departments and agencies with specialized expertise or equipment are often requested to perform services for other departments and agencies. If the government wishes to maximize the efficient use of these services, and to reduce overlapping services, its operational procedures must be changed. In particular, departments and agencies should be permitted to receive, retain and spend funds across fiscal years, in return for services provided to other departments and agencies. The provision of such services to other departments and agencies should be considered to be within their mandates and to be a proper use of their resources.

8. 1993/94 Research Programs — by Department and Agency

In this section of the report, the research strategies, goals and programs are outlined for each department and agency. Each organization provided a written document describing their 1993/94 technology plans. The task group then met with representatives of the organization to seek additional clarification and to obtain missing information.

8.1 Alberta Advanced Education

(a) Background

The development of Alberta during the last three decades was greatly helped by the contribution made by the post-secondary education system. The province has a highly educated labour force which is quick to adapt new skills.

Graduates of Alberta's universities, technical institutes and colleges provide the knowledge and skills required by a modern economy. In 1991, 40.9% of the Alberta labour force held post-secondary qualifications, the fourth highest of any province. We ranked second, however, in terms of the percentage of our overall population aged 15 and over that held post-secondary credentials.

The lower provincial ranking of Alberta (4th highest) in terms of the educational attainment of the labour force relative to the education attainment of the population (2nd highest) is due mainly to the generally higher labour force participation rate of Albertans at the lower levels of educational attainment as compared to their counterparts elsewhere in Canada.

Basic or fundamental research performed at Alberta universities adds to the general stock of knowledge on which social, economic, and scientific/technical progress is made. The performance of basic research is also critical to the training of highly qualified manpower.

Alberta's universities are major performers of research and development funded directly through grants and contracts by the province ($34 million in 1990-91). The province also benefits from the research conducted at Alberta's universities funded by federal government sources ($70.5 million in 1990-91). Research conducted at the universities helps provide the knowledge required to help ensure the long term viability of the province's major industries whether through the application of knowledge to natural resource industries such as energy, forestry or agriculture, in the emerging medical and biological fields, or in the various high technology areas.

NAIT, SAIT and the public colleges educate the technologists and technicians required by industry. Human resource development through advanced education and training is increasingly recognized as central to economic performance and competitiveness whether in research-related or other areas of our economy.

(b) Department Objectives

- To provide post-secondary services and programs to Albertans to meet current and anticipated social and economic needs.
- To provide basic infrastructure support for Alberta's post-secondary institutions through the provision of annual operating and capital grants.
- To achieve an appropriate balance in the teaching and research functions of Alberta's universities recognizing the importance of each function to Alberta's social and economic well-being and the synergy between these functions.
- To continue to educate and train the next generation of highly qualified manpower, including scientists and engineers, to enhance Alberta's competitive position in the new global economy.

- To continue to support fundamental research at Alberta universities with a view to reinforcing excellence and building on strength.

(c) Proposed Investment Level

In 1992-93, the department provided over $459 million in operating support and approximately $18 million in capital 'formula-funding' support to Alberta's three residential universities. Of this amount, the department estimates that approximately $183 million in operating support and $6 million in capital support will be devoted by the universities to support research. 1993-94 proposed estimates are not available at this time.

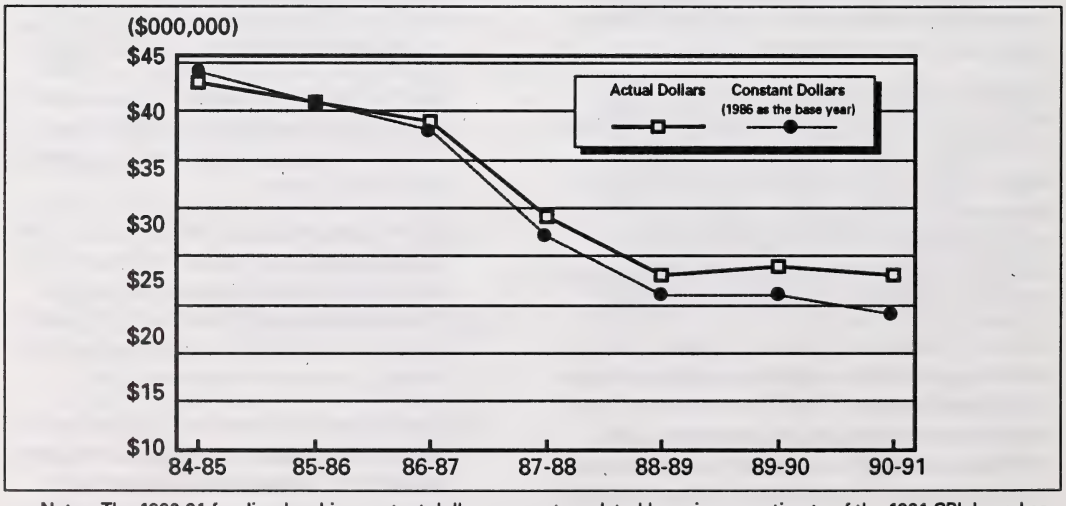
It is estimated that in 1992-93, more than $150 million was received by Alberta's three residential universities in support of sponsored research. (In 1990-91, the most recent year for which audited figures are available, the comparable income figure was over $140 million.) Sponsored research funding at Alberta's residential universities increased 330% between the years 1979-80 to 1990-91, from just over $32 million to over $140 million. Most recent data indicate that the University of Alberta and The University of Calgary rank fourth and eighth respectively among Canadian universities in terms of level of sponsored research funding received.

Alberta universities continue to command an increasing proportion of federal peer-reviewed awards from the three research granting councils. For example, federal granting council funding to Alberta universities increased by approximately 33% over a two year period alone (between 1988-89 and 1990-91), growing from approximately $44.9 million to approximately $59.7 million. During the same time period, provincial funding decreased by 31.4% from approximately $49.1 million to approximately $33.7 million.

(d) Priority Concern — Capital Equipment Funding

The figure 8.1.1 illustrates the level of reduction

Figure 8.1.1 University Formula Funding Levels 1984-85 to 1990-91



Note: The 1990-91 funding level in constant dollars was extrapolated by using an estimate of the 1991 CPI, based on the average monthly CPI change in the previous year.

Sources: 1. Campus Development Services, Alberta Advanced Education: For actual funding levels.
2. Alberta Statistical Review, Fourth Quarter, 1990; For Alberta CPI (all terms index).

in general capital renewal and replacement funding provided by government to Alberta universities. Using 1986 constant dollars, the universities' level of capital renewal funding has dropped from approximately $38 million in 1984-85 to approximately $15 million in 1990-91. The fund remains at the same level for 1992-93, that is $18 million (in current dollars) for the three residential universities.

The low level of funding provided is of great concern. It is the main source of funding available to the universities to repair and upgrade buildings and building spaces (including labs); maintain, upgrade, and replace furnishing and equipment; and execute site maintenance. It is probably reasonable to assume that approximately 1/3 of these funds are available for research equipment repair, maintenance, upgrading and replacement; that translates to approximately $6 million per year available to the three universities. This is an inadequate level of funding which is beginning to erode the research infrastructure of the universities.

Capital equipment funding is a major concern to the universities and to the department. Work is in progress to address this issue and consultations have been held with the institutions but without additional funding the problems of disrepair and obsolescence will escalate.

(e) Organizations Involved

The department provides operating and capital grants to all of Alberta's universities, technical institutes and colleges. Hence, the department contributes the main source of funds for faculty salaries, buildings, laboratory equipment and space, libraries, support staff and maintenance.

Alberta Advanced Education represents the Alberta Government at inter-department, inter-agency and inter-jurisdiction forums involving higher education issues. As well, the department is represented in the Technology and Research Advisory Committee, the Deputy Ministers' Committee on Research and Development, Policy and Priorities, and the Alberta Agricultural Research Institute.

(f) Expected Impact

Alberta's post-secondary education systems will continue to contribute towards the economic development of Alberta through:

- educating the next generation of scientists, engineers and technicians
- updating the skills and expertise of existing employees
- performing research on behalf of and in collaboration with Alberta industry
- transferring research results to the private sector for commercial development
- ensuring Alberta's participation in national high quality research initiatives, such as the Networks of Centres of Excellence Program, in collaboration with institutions of other provinces
- acting as a source of new companies "spun off" from the universities
- linking Alberta to the national and international research community, and helping Alberta to remain in touch with new research and knowledge.

Alberta universities have increased their partnerships with the private sector. Some examples of technology transfer and the contribution of university research to Alberta's social and economic well being include:

- Synphar Laboratories Incorporated — the first pharmaceutical research and development company in western Canada and the only Canadian pharmaceutical firm funded by a Japanese company. A joint venture of Taiho Alberta Limited and Dr. Ron Micetich, Adjunct Professor in the University of Alberta Faculty of Pharmacy, the firm is the result of a decade of collaboration between these two partners.
- SciCan Diagnostics Limited — a privately-owned company specializing in research, manufacturing and distribution of a broad range of diagnostic and research products for medical community. SciCan was created by government and university collaboration led by Dr. Tom Wegmann, Professor of Immunology at the University of Alberta.
- Biomira Incorporated — established in 1985 to produce and market products for cancer diagnosis and treatment based on patented monoclonal antibody technology developed by University of Alberta researchers Dr. Tony Noujaim and Dr. Michael Longenecker.
- At The University of Calgary, researchers developed a test kit that offers a solution to a corrosion problem faced by industries that use metal pipes to transport liquids.
- The University of Calgary's multi-disciplinary Joint Injury and Diseases Research Group is working in diagnosis and treatment of arthritis and injuries to joints which precede this disease.
- Research institutes such as TRLabs, the LASER Institute and the Alberta Microelectronic Centre are examples of government, university and industry collaboration to further strengthen the Alberta economy in high-technology areas. The presence of TRLabs in particular draws a cluster of telecommunications businesses to Alberta, further enhancing economic growth and expertise in telecommunications technology.
- Motorola Military and Aerospace Electronics Ltd. has committed $300,000 to The University of Calgary to train graduates and conduct relevant research in software development. The University of Calgary's wholly-owned subsidiary, University Technologies International (UTI) played a key role in securing the Motorola funds. Motorola has also announced plans to purchase 25% of The University of Calgary spin-off company ACTC Technologies, a firm specializing in software engineering.

8.2 Alberta Family Life and Substance Abuse Foundation

(a) Background

The Foundation was established through legislation in September 1991 with the purpose of strengthening Alberta families through the discovery and application of new knowledge about substance abuse. The Foundation supports innovative applied research and demonstration projects on substance abuse and the relationship between substance abuse and individuals, families and communities.

A Board of Trustees was appointed in March 1992 and is overseeing the development of the Foundation, including its goals and programs. A request for research proposals was issued in June 1992 through the Foundation's Research Program. The Foundation will select the proposals to be funded during the fall of 1992.

(b) Foundation Objectives

The objectives of the Foundation are to strengthen Alberta families through the discovery and application of new knowledge about substance abuse by supporting:

(i) the development and evaluation of new educational and public awareness programs on family life and substance abuse,

(ii) the development and evaluation of new methods for the treatment of substance abuse,

(iii) innovative basic and applied research projects on the relationship between family life and substance abuse and other innovative studies in the field of substance abuse,

(iv) the evaluation of proposed and current programs relating to family life and substance abuse, and

(v) the development of an information base on family life and substance abuse in Alberta.

(c) Proposed Investment Level

It is expected that the Foundation will be funding projects from agencies, universities and industry, with the majority of funds likely going to agencies and universities. The Foundation does expect that many of the proposals it funds will be jointly funded by other organizations.

The amount of $5,000,000 has been allocated to the Foundation for the 1992-93 fiscal year. Although it is not possible to know how the funding will be distributed between R&D and RSA, the Foundation is requesting proposals for program evaluation, program development and pilot projects, information gathering and research into the causal relationships between substance abuse and family life. As well, Foundation administration costs will be included in this $5 million.

The Foundation currently support three full-time staff members and a nine-member Board of Trustees.

(d) Capital Budget

As a funder of research, the Foundation does not expect to purchase equipment for research but may fund in part equipment purchases necessary for particular projects.

(e) Organizations Involved

The Foundation will work with related government, academic and community organizations in the areas relating to the family and substance abuse, to ensure complementarity and co-ordination of activities and priorities. The Foundation will also work with industry and private companies to encourage joint funding and ongoing support for projects.

The Foundation liaises with government departments through its membership on the TRAC Sub-Committee on Health Research.

(f) Key Program Elements & Impact

The Foundation has prepared a research program which will fund research proposals in the areas of substance abuse and family life. Proposals requested included those to perform basic research in the area of the relationship between family life and substance abuse, and to develop and evaluate programs to prevent or treat substance abuse.

The evaluation of existing programs and the development of new programs is expected to result in the improved quality of services available in the areas of substance abuse and family life. The funding of basic research

concerning substance abuse and its relationship with family life will provide knowledge with which to enhance prevention strategies. The improvement of services combined with additional information concerning the prevention of substance abuse, will result in increased health and quality of life for Albertans.

8.3 Alberta Agriculture

(a) Background

Agriculture is a multibillion dollar industry in Alberta. Primary production is conducted on 57,245 farms (1991) spread out across 20 million hectares of land. In 1990, farm cash receipts amounted to approximately $4.2 billion. A steadily growing agricultural processing industry has also taken root in the province. The annual value of processed food products in Alberta is estimated at $4.9 billion.

An estimated 25% of Alberta's labour force is employed directly or indirectly in the food industry. This represents the largest single employer by sector in Alberta.

A substantial volume of Alberta's primary and processed agricultural products is sold outside the province. In 1991, the total value of out-of-province shipments to other parts of Canada and the rest of the world was estimated at $3.86 billion. Approximately 65% or $2.52 billion was earned from exports to other countries, while 35% or $1.34 billion resulted from sales to other parts of Canada. Table 8.3.1 illustrates the distribution of out-of-province shipments between exports to foreign countries and sales to other parts of Canada.

The productivity of the agriculture sector has increased many-fold due to the development of advanced crop and animal varieties, and efficient farm and food processing equipment. Agri-food research conducted in Alberta covers many topics. These topics range from soil and water to food processing and marketing. They involve all the intricate activities required to get food to the consumers table. About 300 agricultural scientists employed by the federal governments, academic institutions and the private sector work in Alberta. In addition, Alberta Agriculture has a significant number of agricultural professionals who help transfer new technology to producers and agricultural processors.

Table 8.3.1 Alberta's Agricultural Exports and Out-of-Province Shipments — $000 (1991)

	Exports	Shipments to other Provinces	Total Shipments out of Alberta
Primary Products (1)	1,842,995	404,731	2,247,726
Processed Products(2)	675,149	936,657	1,611,806
Total	**2,518,144**	**1,341,388**	**3,859,532**

(1) Live animals, grains and oilseeds, and all other crops.

(2) All agricultural commodities excluding primary products.

Source: Statistics Branch, Alberta Agriculture

Marquis wheat, licensed in 1909, was the first crop variety ever developed in Canada and was the forerunner of a stream of technological advances that changed Alberta's agricultural landscape. Today, almost all the crop varieties produced in Alberta, including hard red spring wheat, canola and barley were developed by Canadian researchers, many of them working in Alberta. For instance, Alberta is one of the world's leading centres for barley research. Alberta Agriculture's crops research program in feed grains has resulted in the development of a number of excellent feed barleys, the most recent being Condor, a hulless variety with improved feeding value and Sampson, a semi-dwarf six-row feeding barley. These new varieties represent major improvements in yield, agronomic performance and feeding value and are being quickly accepted by Alberta farmers. As a result, the overall benefit to the province's agriculture and food industry from Alberta Agriculture's crop research program at Lacombe is estimated to be in excess of $94 million per year.

Alberta is Canada's leading beef producer. The sale of cattle and calves contributed $1.56 billion to Alberta's farm cash receipts in 1990. Scientific research supported by Alberta Agriculture and other organizations has steadily improved cattle production and the rangelands on which they depend. Better breeding techniques, advances in animal nutrition and new approaches to the prevention and treatment of animal diseases have promoted a robust cattle industry. As a result, the quality of Alberta cattle is gaining recognition around the world. Continued intensive agricultural research is expected to give Alberta the technological advantage required to compete in the current global climate of fierce and subsidized competition. Alberta Agriculture, together with the Alberta Agricultural Research Institute and associated federal and provincial academic and private sector organizations, are part of a well co-ordinated research network. Co-operation between these research organizations provides the ongoing technology that is needed to achieve the objectives of this highly decentralized and important sector of the Alberta economy.

(b) Department Objectives

Alberta Agriculture will concentrate its research efforts on generating new information and technology that will improve the global competitiveness, profitability and long-term sustainability of the agriculture and food industry. The department's research activities are carried out by its various divisions. Therefore, the department's research priorities reflect the integrated priorities of the research performing divisions of the department.

The following is a list of departmental research priorities:

1. *Agricultural Processing Research* to strengthen and expand the capability of Alberta's food processors to meet the challenges of the marketplace and to ensure that the safety and quality of the food supply is maintained.
2. *Crop Production Research* directed towards production efficiency and crop diversification as well as improved management systems.
3. *Land and Water Resources Research* to promote the stewardship of agricultural soil and water resources to sustain the productive capability of Alberta's natural resources.

4. *Livestock Production Research directed towards* production efficiency including nutrition, animal health and management studies.

5. *Agricultural Economics and Marketing Research* to provide accurate up-to-date information on economic, financial, legal, marketing and taxation issues for Alberta producers and food processors.

(c) Proposed Investment Level

1. The proposed provincial investment in agri-food research and related scientific activities through Alberta Agriculture is nearly $24 million. Table 8.3.2 provides a detailed breakdown of the anticipated investment:

The budget estimates for R&D and RSA is higher than last year due to re-examination of activities for 1993/94 and does not reflect any increase in S&T budgets.

2. Budget Identified to Support Research and Development in Other Agencies, Universities or Industry

Alberta Agriculture has the primary responsibility for agricultural research within the Government of Alberta. The department conducts intramural research in a number of areas and collaborates with several research performing organizations, such as Alberta Environment, the Alberta Research Council, Agriculture Canada, the University of Alberta and private sector organizations. The major areas of intramural research include crop research, livestock research, economics and marketing studies, food processing research, irrigation research and agricultural engineering research.

Table 8.3.2 Alberta Agriculture Estimated Expenditures For Research & Development And Related Scientific Activities

Estimated Divisional Research Expenditures			1993-94 Fiscal Year
Divisions	Budget Estimate		
	R&D	RSA	Person Years
Alberta Agricultural Research Institute	5,135,000	715,000	
Animal Industry	265,000	512,000	18
Economic Services	684,000	171,000	15
Field Services Sector	528,000	1,971,000	12
Irrigation and Resource Management	585,000	585,000	35
Processing Services Sector	1,264,000	1,206,626	41
Planning Secretariat		500,000	
Plant Industry	6,889,816	2,397,386	174
Research		440,862	13
Total	15,350,816	8,498,874	308
Grand Total	$23,849,690		

3. The Impact and Program Changes as a Result of Last Year's Budget Cuts

Last year's tight budget have resulted in a reduction of personnel, and a loss of purchasing power. Some services have been decreased. However, maintaining capability remains a very high priority in the department. In many divisions funds were diverted from other areas to maintain activities. Fewer funds were available for short term employees, contract research, and for the acquisition of equipment and other capital assets. Wage and temporary salary employees have, in the past, provided a significant contribution to research and development and related scientific activity.

In order for Alberta Agriculture professionals to remain on the cutting edge of new technological advances in the industry, it is essential that lines of communication between agricultural researchers remain open. Restrictions in travel commitments reduced staff opportunities to

Table 8.3.3 Alberta Agriculture Estimated Budget For Research Conducted In Collaboration With Other Agencies, Universities Or Industry By Program[1,2]

Program	Research Agencies	1993-94 Budget Estimate
Poultry Research Centre	University of Alberta	185,000
New Crop Variety Testing	University of Alberta Agriculture Canada Alberta Environment	790,969
Livestock Research	University of Alberta Private Sector Agencies	80,000
Agricultural Engineering	Alberta Research Council Agriculture Canada University of Alberta Canadian Standards Association	28,000
Laboratory Analytical Service for Soil	University of Alberta Agriculture Canada Private Industry Alberta Agriculture	500,000
Applied Research Operations	Applied Research Associations	400,000
Total		$1,983,969

1. Other research funding bodies also contribute funds to support scientific activities in these research agencies.
2. Approximately 60% of the budget allocated by Alberta Agriculture for collaborative work with other agencies goes toward manpower.

make industry visits and to maintain technological awareness through attendance at national and international conferences or expositions. Budget restrictions on travel have also made it difficult for technicians to maintain research plots around the province.

While agricultural research and related scientific activities remain a high priority, budget reductions have restricted the department's flexibility to address emerging issues important to the agri-food industry. Strategic research alliances with applied research agencies, universities and industry may be in jeopardy. Long term research agreements between Alberta Agriculture and other research bodies are very difficult to initiate and carry out with the present research budget and uncertainty over future funding. For instance, Alberta Agriculture's Field Crops Branch has just entered into a five-year agreement with Agriculture Canada to co-ordinate and assume responsibility for Agriculture Canada's barley breeding program. In order to fulfil these agreements, long term research funding commitments must be provided.

Increased activity with applied research associations provides excellent technology transfer opportunities and is also cost effective. In many cases, the funding applied research associations received from Alberta Agriculture is matched by donations from producer groups and private industry. If research funding from Alberta Agriculture is curtailed, matching research funds from the private sector may also be reduced.

4. The Capital Budget for Research

Recapitalization is difficult under the present budget constraints. Any major initiatives that require capital funds have been held back or other funding alternatives have been explored. Reductions in capital budgets diminish the ability to carry out co-operative research projects. In addition, the department is falling behind in the purchase of the advanced equipment needed to address future industry needs. This is a very serious issue hampering our ability to maintain sophisticated laboratory capability and replace other research equipment.

Future agricultural research will be jeopardized if the recapitalization issue is not addressed. For instance, a lack of controlled environment facilities is having a detrimental effect on plant breeding research conducted by the department. A recapitalization Plan is currently under discussion in the department.

In order to remain current and provide leadership to the agriculture and food industry, creative solutions must be developed to ensure that capital requirements are met.

(d) Organizations Involved

In addition, a number of other Alberta Government agencies, Agriculture Canada, academic institutions and private sector organizations are involved in agricultural research. Alberta Agriculture collaborates very closely with these organizations.

Alberta Agricultural Research Institute

The Alberta Agricultural Research Institute (AARI) is a provincial Crown corporation whose primary purpose is to co-ordinate, promote and financially support agricultural research in Alberta. Alberta Agriculture has a close , co-operative working relationship with the Institute. Alberta Agriculture representatives are key members of the AARI Board of Directors and committees. The department also provides administrative facilities and functions for the Institute.

Alberta Agriculture, along with representatives from the other agricultural research bodies in the province, assist the AARI in the promotion and co-ordination of agricultural research. The Institute supports agriculture and food research in both public and private sectors through open, competitive grants. Project review mechanisms have been established to ensure that projects complement efforts of Alberta Agriculture and other research organizations.

Other Alberta Government Agencies

The Alberta Environmental Centre (AEC), located in Vegreville, provides diagnostic and testing services for insects, plant diseases and weeds. It tests for chemical damage to plants, conducts soil analysis and provides toxicological services related to plant and animal health. The AEC also conducts research into chemical and biological control of weeds, insect control, plant pathology, and intensive management of wildlife.

The Alberta Research Council (ARC) conducts several programs that relate to agriculture. It carries out soil surveys independently and operates a soil analysis laboratory jointly with Alberta Agriculture and Agriculture Canada. The Alberta Research Council also has a large biotechnology scale-up pilot plant in Edmonton.

Alberta Agriculture conducts co-operative projects and shares technical expertise and resources with the Alberta Research Council and the Alberta Environmental Centre.

Agriculture Canada

Agriculture Canada is the leading performer of agricultural research in Alberta and has a substantial investment in land buildings and equipment. This federal department has three major research stations in Alberta located at Lethbridge, Lacombe and Beaverlodge. The stations operate substations to study problems associated with different soil and climatic conditions. A number of Alberta Agriculture programs are carried out in co-operation with these stations. These include research in soil, water and environment, pests, livestock, crops and apiculture.

Agriculture Canada also operates the Animal Disease Research Institute located in Lethbridge. The Institute is a unit of the Health of Animals Directorate within Agriculture Canada. The Institute's research program is designed to serve the National Animal Health Program and the National Agri-Food Safety Program. Both programs are national in scope and regulatory in nature.

Alberta Agriculture collaborates with Agriculture Canada on many research initiatives. The department also shares technical expertise and certain facilities with the federal researchers.

Academic Institutions

Academic institutions have been equal partners in the research effort. The University of Alberta, for example, has produced high quality scientists and carried out its own programs of research for 75 years. Other academic institutions involved in research include the Western College of Veterinary Medicine, the Veterinary Infectious Disease Organization(VIDO), The University of Calgary, the University of Lethbridge and the Agricultural College in the province. Alberta Agriculture co-operates with these institutions on research projects of mutual interest and shares some analytical facilities with them.

Private Sector Organizations

Although private sector participation in agricultural research has been increasing, industry generally limits its involvement to studies which promise short-term payoffs on invested funds. Such areas currently include agricultural chemicals, mechanical technology, food product development and quality control, specific crop breeding and variety trials and automated systems and monitoring devices.

Producer organizations have substantially increased their involvement in applied research over the last ten years. It is expected that the trend will continue since producer involvement in research encourages a self reliant industry and will make the producers more competitive in the world market.

Private sector organizations rely on government agencies like Alberta Agriculture to undertake collaborative research projects. Alberta Agriculture provides the technical expertise, research facilities and the leadership to encourage research alliances. The department also has a primary responsibility for transferring agricultural technology to producers and processors.

(e) Alberta Agriculture Key Program Elements

Agricultural Processing Research

Purpose: To conduct research into the development of new food products, improved processing techniques, new packaging methods, food safety, quality and nutritional value.

Expected impact

- New product development with a longer storage life and environmentally friendly packaging will increase marketability.
- Increased co-operation will occur between government institutions, universities and Alberta's food processors in the area of technical assistance, consultations and demonstrations of new technologies and utilization of specialized equipment.
- Food quality and safety research will ensure that the safety and quality of the food supply is maintained and enhanced.

Location: Leduc and Edmonton

Achievements include:

The Development of Modified Atmosphere Packaging of Convenience Foods

Quality Fast Foods and Alberta Agriculture collaborated on a research project to adapt the Modified Atmospheric Packaging technology for horizontal sandwich wrapping machines. Flushing the product with carbon dioxide reduced the oxygen content in the food and suppressed the formation of molds and spoilage bacteria. As a result of the longer shelf life, Quality Fast Foods has increased its sales from $300,000 in 1980 to $8 million in 1990. The number of employees has increased from 12 to 55.

Crop Production Research

Purpose: To conduct applied, adaptive problem solving and developmental research to improve crop productivity.

Expected impact

- Development of improved varieties of feed grains with emphasis on feed barley. Programs are also conducted on spring and winter triticale and winter wheat for the various agro-climatic regions of Alberta.

- Province-wide development of new and improved varieties of horticulture and irrigated specialty crops, including nursery crops, vegetable, seed potato, greenhouse crops, herbaceous perennials and woody ornamentals.
- Better solutions for Alberta's crop production problems and improved crop management systems will be devised.
- Techniques to improve the agricultural productivity of solonetzic, luvisolic, organic and acid soils in Alberta will be developed.
- New weed and pest management strategies will be introduced to reduce crop losses and lessen the environmental impact of weed and pest management practices.
- Weed and pests analytical services and diagnostic services will be made available to farmers and private agency researchers.
- Engineering research on crop production systems including seeding, spraying, tillage, and harvesting.

Location: Edmonton, Lethbridge, Brooks, Lacombe, Airdrie, Red Deer, Vermilion, Barrhead and Fairview

Achievements include:

Breeding Barley for Swine Feed

Barley used as swine and poultry feed is less competitive than corn and wheat due to its high fibre and low lysine amino acid levels. Alberta Agriculture's barley breeding program which began in 1973, addressed this problem by developing a feed barley with lower fibre, increased lysine and greater energy. Condor barley, registered in 1988, was the result. The new variety is high yielding and possesses a unique combination of hullessness and high protein, making it ideal for use as a major component in hog and poultry operations. Recent feeding trials at the University of Alberta indicated that using the hulless Condor barley in swine rations will reduce the cost of feeding swine by 7%. Accordingly, the results of Alberta Agriculture's barley breeding effort can benefit the province's swine industry by approximately $7 million annually. Barley producers would also see increased revenue of over $2.5 million per year from the sale of Condor barley.

Land and Water Resources Research

Purpose: To plan, design and conduct research into soil and irrigation water management problems that hinder the achievement of optimum crop production levels.

Expected impact

- New soil conservation practices and farm water management technology will help ensure environmentally sustainable agricultural production in Alberta.
- Irrigation programs will develop and promote the adoption of on-farm irrigation and drainage technology.
- Analytical services to test and diagnose soil nutrient deficiencies and water quality evaluation will be made available to farmers.

Location: Edmonton, Lethbridge

Achievements include:

Canada-Alberta Soil Conservation Initiative (CASCI)

CASCI is an agreement on soil conservation signed by Alberta and Canada to promote soil conservation in Alberta. The agreement

provided $34.8 million over a three-year period, from 1989 to 1992. CASCI introduced new programs designed to demonstrate soil conservation practices to producers and also augmented existing conservation programs in Alberta. Agricultural service boards and producer organizations were the main vehicles for the delivery of the on-farm conservation programs. Programs included: demonstrations and local promotion of soil and water conservation practices; producer assistance to regenerate eroded soils; provide to producers specialized soil conservation equipment; assistance in establishing field shelterbelts for conservation; and monitoring, surveying and documenting soil quality in Alberta. A new Alberta-Canada soil conservation agreement in accordance with the federal government's Green Plan called the "Canada — Alberta Environmentally Sustainable Agriculture" Agreement (CAESA) is now under negotiation.

Livestock Research

Purpose: To conduct research into animal nutrition, animal health and animal reproduction.

Expected impact

- Improved livestock nutrition, health, breeding and management techniques and animal welfare will help to increase profitability.
- Analytical services for livestock feeds to improve feeding efficiency will be provided.
- Diagnostic pathology services will be provided to livestock producers and animal owners.
- Specialized consultation and field investigation services will help to minimize the production inefficiencies caused by animal diseases.
- Specialized consultation and field investigation services to help minimize the inefficiencies caused by animal diseases.
- Engineering expertise for intensive livestock housing, manure management and odour control systems will help improve efficiency, address environmental issues and increase profitability.

Location: Edmonton, Leduc, Airdrie, Lethbridge , Fairview, Red Deer, Vermilion, and Barrhead.

Achievements include:

Ruminant Feed Evaluation Unit

The purpose of the Ruminant Feed Evaluation unit is to determine the digestibility of Alberta grown forages and feed barley. The unit provides detailed individual producer recommendations on rations and feeding programs. Extension activities include promoting the use of feed testing to improve animal performance and to prevent problems. Information is also provided on nutrient profiles of Alberta feeds and trace mineral nutrition. Research projects include ammoniation of high moisture barley to improve feeding value, new testing methods for amino acid determination in feeds and the utilization of field peas for swine and poultry diets.

Agricultural Economics and Marketing Research

Purpose: To conduct research in socio-economics and marketing issues important to agricultural producers, farm families and agricultural processors.

Expected impact

- Information will be provided to producers on production economics, farm finance, agricultural policy, supply and demand of agricultural commodities, market trends, global competitiveness, trade policy and buyer/consumer preferences.
- New information to assist the family farm and rural community development, including help on farm financial management, health and farm safety concerns will be addressed.

Location: Edmonton, Olds, Lethbridge, Airdrie, Red Deer, Barrhead, Fairview, Vermilion.

Achievements include:

An Economic Impact Analysis of a Prairie-Wide Change in the Method of Payment of the Crow Benefit on the Grain and Livestock Sectors

It has been hypothesized that a change in the method of payment of the Crow Benefit from a policy of paying the railroads to a direct farmer payment would improve the economic situation for farmers and processors throughout Western Canada. The need to analyze the economic impact of this change was identified by Alberta Agriculture staff in 1990. The task of the resulting research project was to develop a detailed quantitative Prairie-wide model which could be utilized to analyze the economic impact of a change to the method of payment. The proposed change to the method of payment was a buy-out of the Crow Benefit from the landowners of freehold arable land that is within the Canadian Wheat Board designated area. The economic analysis undertaken in the study indicated that a policy of buying-out the Crow Benefit would result in positive changes in the price farmers receive for their grains, oilseeds and certain livestock. The total Prairie agricultural economy analyzed would benefit by a 8.4% or some $695.1 million increase in revenue.

8.4 The Alberta Agricultural Research Institute

(a) Background

The Alberta Agricultural Research Institute (AARI) is a provincial Crown corporation governed by a board of directors appointed by the Associate Minister of Agriculture. The Institute plays an important role in Alberta's agricultural research effort. Its primary objectives are to support and implement agricultural research programs that are of benefit to agriculture and food processors. To facilitate strong linkages and co-ordination among agricultural research organizations, the make-up of the Institute Board was purposely designed to include representatives of Alberta Agriculture, Agriculture Canada, other relevant provincial departments, the universities and the private sector. The broad contacts maintained by the Institute help to promote the spirit of building Alberta's agri-food industry.

The Institute's plan is to continue, as it has effectively done over the last six years, to manage research grant programs, evaluate research proposals, co-ordinate research activities and disseminate research information. It will also support and promote

high priority research areas. The Farming for the Future Program and the Matching Grants Program will be instrumental in this regard. The Institute's support for agri-food research, therefore, assists the research performing organizations to carry out research of high priority to the agriculture and food industry.

Research is needed. Moreover, it generates very good returns. Various studies suggest technology-oriented agricultural research produces high annual rates of return. In a recent evaluation of the Farming for the Future Program conducted by the University of Alberta indicated that the annual return to the Alberta economy from the $55.6 million invested between 1979 and 1981 was estimated at approximately $37.5 million. The aggregate returns assuming a 25 year life span of the technology will be $939 million. Few private business or public investments, except education, are likely to yield such returns.

(b) Objectives of the Alberta Agricultural Research Institute

The objectives of the Alberta Agricultural Research Institute for the next five years will be to:

1. Strengthen co-ordination;
2. Financially support research in:
   - agricultural marketing
   - agricultural processing
   - agricultural production and
   - soil and water conservation
3. Transfer technology to the agri-food industry through:
   - department specialists and extension staff
   - demonstrations
   - direct computer access to research results and
   - publications.

Institute funds are available to researchers in the public and private sectors through open, competitive grants. Appropriate project review mechanisms involving farmers, researchers and Alberta Agriculture staff have been established to ensure that the projects selected for funding complement existing efforts of Alberta Agriculture and other organizations.

Through well managed competitive grants the Institute will:

1. identify and support high priority research projects that are not being adequately funded through existing organizations,
2. encourage the private sector to invest in research by providing matching grants,
3. allow fuller utilization of the research infrastructure and highly skilled agricultural researchers within the province, and
4. accelerate the completion of research projects.

The Institute administers six research assistance programs that relate to Alberta's agri-food industry, the Matching Grants Program, the Research Co-ordination Program, the Research Professorship Program, the National Agricultural Biotechnology Initiative, the Farming for the Future Research Program and the Farming for the Future On-Farm Demonstration Program.

1. The Matching Grants Program

Under the Matching Grants Program, the Institute matches, on a 50:50 basis, contributions for approved research projects from the private sector and other eligible sources. The Matching Grants Program is primarily intended to attract research co-operation from the private sector.

2. The Research Co-ordination Program

The Research Co-ordination Program is designed to provide scientists involved in agricultural research with financial support in order to promote co-ordination and communication among researchers involved in similar work or multidisciplinary research.

3. The Research Professorship Program

The purpose of the Research Professorship Program is to raise the research priority of selected target disciplines of importance to Alberta's agricultural sector and intensify the scientific effort directed to them.

4. The National Agricultural Biotechnology Initiative

The purpose of the National Biotechnology Initiative is to support the development and commercialization of agricultural biotechnology. Projects are eligible after a genetically engineered plant or other organism has shown characteristics that the potentially marketable, or the new biotechnological methodology has been successful.

5. Farming For The Future Research Program

The Farming for the Future Research Program is financially supported by the Alberta Heritage Savings Trust Fund. The purpose of the Program is to finance agricultural research which benefits primary producers and food processors. The projects that are supported within the Research Program are chosen on the basis of several criteria, including their ability to enhance the long-term viability and profitability of Alberta's primary producers. Since the beginning of the program in 1979, over $59.4 million has been awarded to 746 research projects.

6. On-Farm Demonstration Program

The specific goal of the Farming for the Future On-Farm Demonstration Program is to accelerate the transfer of new technology to producers. Under this program, farmers, Alberta Agriculture staff, and research scientists work together to demonstrate agricultural innovations in action.

(c) Proposed Investment Level

1. Program Funding

The Institute needs continued funding to co-ordinate, support and strengthen the technology base needed to maintain a competitive and profitable agri-food industry. Its activities will augment and complement, not duplicate, the efforts of Alberta Agriculture and other organizations.

The Institute's 1993/94 budget is estimated at $5.85 million. In 1992/93, the AARI total budget was $7.5 million, $5.86 million from provincial funds and the remainder from Western Economic Diversification accumulated interest and fees.

Table 8.4.1 Alberta Agricultural Research Institute Estimated Expenditures For Research And Related Scientific Activities in $

Program	1993-94
Research Funding	4,200,000
Technology Transfer and Utilization	715,000
Research Co-ordination	55,000
Research Professorships	400,000
Institute Administration	480,000
Total	$5,850,000

2. Budget Identified to Support Research and Development in Other Agencies, Universities or Industry

Approximately 6% of the Alberta Agricultural Research Institutes's annual budget is utilized for administration of its programs. The remainder of the budget is used to support agricultural research conducted by various research agencies in Alberta.

Table 8.4.2 shows the total funds awarded to research institutions in western Canada to carry out the approved research projects of the Farming for the Future Program, the Matching Grants Program, the Research Co-ordination Program and the Research Professorship Program in 1992/93.

3. Number of People Supported by Agricultural R&D and RSA Investment

Table 8.4.3 details the person-years devoted to the research supported by the Alberta Agricultural Research Institute.

Table 8.4.3 Alberta Agricultural Research Institute Estimated Person-Years Devoted To Research

Staff	Person Years
AARI Administration Staff	7
Research Project Staff	150
Total	157

Table 8.4.2 Farming for the Future, Matching Grants, Research Co-ordination and Research Professorship Program Expenditures Approved for Research Projects by Performing Institution and Research Program Area 1992-93 in $

Research Program Area	Alberta Agriculture	Agriculture Canada	Alberta Environment	Private Industry	University of Alberta	Other University	VIDO[1]	WCVM[2]	Total Funds
Beef & Dairy	46,000	528,572	–	89,000	539,000	18,000	208,000	237,200	1,665,772
Cereals and Oilseeds	186,725	754,377	115,500	10,000	257,590	141,812	–	–	1,466,004
Forage, Pulse, Vegetable & Other Crops	163,483	477,730	68,250	24,665	181,477	–	–	–	915,605
Pork, Poultry, Sheep & Other Livestock	–	213,442	–	–	634,207	30,000	137,025	124,352	1,139,026
Policy, Economics & Marketing	–	–	–	–	268,256	–	–	–	268,256
Resource	226,827	11,451	–	–	215,980	17,200	–	–	471,458
TOTAL	623,035	1,985,572	183,750	123,665	2,096,510	207,012	345,025	361,552	5,926,121[3]

[1]VIDO — Veterinary Infectious Disease Organization

[2]WCVM — Western College of Veterinary Medicine

[3]These figures include contributions from other sources

4. The Impact and Program Changes as a Result of Last Year's Budget Cuts

The impact of program changes as a result of last year's budget cuts has been minimal. The Institute was able to maintain its expenditures by drawing upon budget reserves from past years.

5. The Capital Budget for Research

The Alberta Agricultural Research Institute assumes that the entities it funds will provide the facilities and fixed assets for the projects which are supported. The Institute is very concerned over the inability of these entities to provide adequate facilities for the research projects they propose. The present level of allocation of capital funds is inadequate to replace aging equipment and to purchase the latest scientific equipment to keep Alberta at the forefront of agricultural technology.

(d) Alberta Agricultural Research Institute Key Program Elements

Agricultural Marketing Research

Purpose: To fund, facilitate and co-ordinate research into agricultural marketing that provides information on consumer preference, market demand and international trade.

Expected impact

- Up-to-date information will be provided on agricultural policy issues, supply and demand of agricultural commodities, market trends, global competitiveness, trade policy and buyer/consumer preferences.
- New information generated will assist with family farm and rural community development, farm financial management, and improved health and safety.

Achievements

Risk and Return Dimensions of Cow-Calf Enterprise

This study will provide an understanding of the risk and return in cow-calf enterprises and the relationship to grain operations. This will enable Alberta cattle producers to make better and more informed investment choices.

Effects of Advertising and Demographics on the Demand for Beef

The results of this project will provide insight into the effect of advertising and demographics on the demand for beef products and provide direction for future promotion campaigns.

Other accomplishments

- Impact of trade barriers on the canola crushing industry
- Information of the beef price cycle and responses by cow-calf producers to changing prices
- New approaches for estimating risks and returns from various crops and various farming enterprises
- New information on the importance of price, quality and "brand loyalty" in determining the world market share for wheat
- Study of basis behaviour in the western Canadian canola market

Agricultural Processing Research

Purpose: To fund, facilitate and co-ordinate agricultural processing research that will help expand the profitability of the processing sector by adding value to agricultural raw materials and developing new products or packaging techniques.

Expected impact

- Further development of food processing will add value to Alberta produced commodities.
- Increased new product developments will achieve increased product shelf-life and increased marketability.
- Research into food quality and safety guidelines will ensure that the safety and quality of the food supply is maintained and enhanced.

Achievements

Sulfonamide Immunoassays for Drug Screening of Food

Testing for sulfonamides in food items such as pork, honey and milk is very expensive using present technology. One Alberta dairy has estimated its costs for sulfonamide testing at $160,000 per year. This research project will develop immunoassay tests for sulfonamides that will be much cheaper and easier to use, requiring less trained personnel.

Modified Atmosphere Packaging to Extend the Market Life of Meat and Meat Products

Alberta is a net exporter of meat and meat products and it is a leader in such value added meat products as prepared sandwiches. These studies will enable meat and meat product manufacturers to achieve maximum market life of their products allowing them to penetrate distant markets with "fresh" (never frozen) products. This not only reduces energy costs in distribution and marketing, but also meets consumer demands for products that have never been frozen. The key to product preservation in modified atmosphere packaged foods are elevated levels of carbon dioxide, refrigeration, effective gas barriers and good hygiene and sanitation. This dramatically alters the microflora that grows to spoil the food. In fresh meats, market life is extended from a few days to four weeks. Answers to product safety are urgently required to stem public health concerns, or to take steps in processing that will eliminate risks of food-borne illness.

Other accomplishments

- Techniques for developing bacteria that can be used to establish a lactic starter culture industry to service Alberta cheese producers
- A new sauce using Alberta produced canola meal rather than the traditional soybean
- The use of biotechnology to develop an innovative system for the preservation of meats
- The frying performance of canola fats and their effects on convenience food quality

Resource Conservation and Sustainability Research

Purpose: To fund, facilitate and co-ordinate research that promotes the conservation, responsible management and long-term sustainability of Alberta's soil and water resources

Expected impact

- Improved management of irrigation systems will be achieved.
- Soil and water conservation procedures for agricultural soil and water resources will help ensure future productivity.
- Methods to improve agricultural productivity of solonetzic, luvisolic, organic and acid soils in the province will be found.

- The efficient use of agricultural fertilizers and their proper placement in the soil will contribute to lower costs and improved crop productivity.

Achievements

Summerfallow Weed Control with Short-term Cover Crops

The annual value of soil lost from wind and water erosion in Alberta is estimated to be $200 million. Production practices that control wind erosion rely heavily on herbicides for weed control. These practices are expensive and result in the addition of large quantities of synthetic herbicides to the environment. In this research project, weed control on summer-fallow with short-term cover crops should protect the soil from erosion, reduce the cost of weed control and reduce the addition of herbicides to the soil and groundwater.

Marked Increase in Plant-Availability of Applied Phosphate Granules

The majority of cultivated soils in the Prairie provinces are deficient in phosphorus (P) for cereal grains and canola. Despite annual additions to the soil, only 5 to 20% of an application of P is taken up by the crop, with the rest of the P bound up by the soil. In this project, modified slow release P fertilizer granules will be developed. A major increase in the efficiency of P fertilizers and consequently a decrease in application rates might reduce cropping costs by some $5 – $10 per acre.

Other accomplishments

- Methods to control and reduce soil salinity
- Improved techniques for reducing soil degradation
- Improved nitrogen application techniques
- New means of improving dugout water quality
- New methods for improving the efficiency of irrigation systems
- New approach for enhancing nitrogen fixation by alfalfa grown under cool temperatures in northern Alberta

Agricultural Production Research

Purpose: To fund, facilitate and co-ordinate research aimed at improving agricultural production efficiency and developing cost-saving crop and livestock production technologies, including innovations that will improve competitiveness and profitability in the global market.

Expected impact

- Solutions to crop production problems and improved crop management systems will be found and applied thus reducing costs and improving productivity
- Development of improved varieties of cereals crops, oilseed crops, forage crops, pulse crops, vegetable crops and other special crops will increasingly diversify the industry
- Improved livestock nutrition, health, breeding, animal management and animal welfare will improve profitability
- Engineering solutions for intensive livestock housing, manure management and odour control problems will contribute to animal welfare and environmental improvement
- Agricultural engineering expertise for crop production systems including seeding, spraying, tillage and harvesting will help improve efficiency, address environmental issues and improve profitablity.

Achievements

New Formulations for the Enhancement of Vaccine Efficacy

Infectious diseases are one of the major causes of economic losses to livestock producers. Bovine respiratory disease alone caused an estimated $50 million a year loss to the feedlot industry. The improvement of vaccines in this study includes utilizing Interleukin-2 to boost the animal's own immune systems to fight the infectious diseases without introducing undesirable residues into the food chain.

Resistance to Scald in Barley Lines or Cultivars

Scald is the most important leaf disease of barley in Alberta and during the 1991 growing season it was particularly severe. Losses were probably in excess of 10% and this translates into losses in excess of $45 million for the 5.1 million acres of barley grown in the province. This project will provide information on which scald genes should be used by breeders to provide barley with resistance to scald.

Other accomplishments

- Improvements in animal reproduction technology
- Studies on fat and muscle to improve consumer products
- New approaches for improving the nutritive value of straw and wood chips for use as cattle feed
- Improved wheat, canola and barley varieties for Alberta conditions
- New safflower and soybean varieties for Alberta conditions
- Improved methods for controlling potato diseases
- Up-to-date information about removing pesticides from contaminated clothing
- Improved management recommendations for growing various cereal and oilseed varieties
- An efficient air filtration system for tractor cabs to protect farmers during pesticide spray applications
- A new approach for forecasting and controlling grasshopper outbreaks
- Weed control in alfalfa for seed production
- New approaches to improving the condition of native rangeland and pastures
- Developing new dry bean varieties with resistance to bacterial blight
- New potato cultivars suited to Alberta conditions
- A new approach to potato storage, which alters the tuber aging process by merely adjusting storage temperature
- Recommendations for growing high-value alternative crops, such as herbs and spices
- Vaccines to control livestock and poultry diseases
- New recommendations for winter rations for sheep
- Rapid techniques for evaluating livestock feed
- A new technique for improved detection of pneumonia in swine

Technology Transfer and Utilization

Purpose: To fund, facilitate and co-ordinate activities that promote the transfer and utilization of new technology to the entire agriculture and food sector, including producers, processors, consumers and other users.

Expected impact

- Will demonstrate to producers advances in animal management techniques that enhance the health and productivity of livestock
- Will demonstrate new crop varieties for the different agro-climatic zones in Alberta
- Will help producers modify and improve their current production practices under day-to-day conditions specific to their own farming operations
- Will provide producers with the knowledge they need to improve the agricultural sustainability of their operations.

Achievements

Carrot Production and Marketing

A great deal of interest has been expressed by producers in the Northwest region of Alberta in the area of alternate crop production and marketing. In this demonstration, three varieties of carrots will be grown on three different sites in agricultural region #5. These sites will allow producers the opportunity to assess the specialized equipment used for commercial carrot production. Growth and development will also be monitored. Field tours of the demonstration and market development will take place throughout the term of the project. The co-operating organization in this demonstration is the Northwest Peat and Crop Development Association.

Yield Response of Dryland Crops to Various Nitrogen Levels Depending on Predicted Moisture

The primary benefit of this project is to demonstrate to dryland producers how economic rates of nitrogen fertilizer can be determined for optimum crop production. Field plot trials will be conducted at nine sites in southern Alberta to visually demonstrate crop responses to producers. By using up to date crop response information generated from this demonstration, farmers can make an informed decision on how much nitrogen they require for their crops. The co-operating organization in this demonstration is the Western Canadian Fertilizer Dealers Association.

Other accomplishments

- Comparison of cereal and oilseed varieties with particular emphasis on adaptation to different soil and climatic zones
- Study of replacement of summerfallow by winter cereals
- Demonstration of various methods of fertilizer application
- Comparison of cropping systems (crop/fallow and continuous cropping) under zero-till and conventional tillage
- Assessment of cow breeding performance and calf gain following trace mineral supplementation
- Study of bedding options for dairy stalls, including the use of straw-filled 'cow pillows'
- Demonstration of pulse crop management
- Study to determine the feasibility of wild rice production

8.5 Alberta Heritage Foundation for Medical Research (AHFMR)

(a) Background

AHFMR was established by an Act of the Alberta Legislature in 1979. Its mandate was unequivocal: To establish and support a balanced, long-term program of medical research based in Alberta directed toward the discovery of new knowledge and the application of that new knowledge to improve the health of Albertans and all people.

AHFMR was given an initial endowment of $300 million to be assessed for its adequacy after six years. Operations are funded from some of the investment earnings of the endowment to ensure that the fund remains intact. The Foundation was designed to be at arms-length from the Government. It is run by a board of trustees with representatives from the universities, the medical profession and the general community. The Scientific Advisory Council advises on policy and major funding thrusts to ensure activities supported are of the highest standards. In addition, every six years an International Board of Review assesses the productivity and effectiveness of AHFMR.

AHFMR has created a remarkable community of medical researchers in Alberta, who are undertaking advanced medical research in some of the most critical areas of medical health. These include areas of very high public concern, cardiac disease prevention, treatment and cancer diagnosis and treatment. Examples of developments are:

1. The HER-2/Neu probe developed by Heritage Medical scientists is able to predict which women with breast cancer are likely to suffer a relapse. A new company has been started with Vencap support to market this technology.
2. Cardiac teams in Alberta pioneered testing of new pacemaker/defibrillators in Canada. Now more than 30 people have received the device that monitors their heart and provides the necessary stimulation to provide a steady life-giving heart beat.
3. Alberta Heritage Scientists were the first in Canada to successfully transplant insulin producing islets to a diabetic patient. An Albertan is one of only two diabetics in the world who has gone off insulin treatment after receiving transplanted islet cells.

Alberta has an effective health care system but without the supporting research needed to keep at the leading edge of medical practice, there would be a much reduced capability for advanced medical treatment. The hallmark of every world famous health care centre is a mutually supportive blend of research, education and patient care. Research provides the knowledge base on which future advances are made. More important, however, research ensures that in Alberta hospitals, clinics, and classrooms, there is a cadre of skilled individuals who are at the forefront of their fields, and applying the latest advances in knowledge to teaching and patient care.

AHFMR has created a remarkable community of medical researchers in Alberta, who are undertaking advanced medical research in some of the most critical areas of health. They are now ready to build on 12 years of accomplishment and make further contributions to the well being of Albertans.

(b) Program Objectives

In 1992, AHFMR conducted a strategic planning process to determine a direction that would allow it to build on past success and meet the research and health care challenges of the future. The following goals were established.

1. To maintain international standards of excellence through an appropriate and effective peer review system.
2. To manage expenditures to ensure the continuance of AHFMR for future generations while avoiding significant fluctuations in annual spending.
3. To maintain and strengthen basic research in order to discover the underlying causes of disease and provide a foundation for patient and health research, the practice of medicine and prevention of disease.
4. To expand AHFMR support of patient-based and health research in Alberta and lead new initiatives in these areas.
5. To maintain research education and training programs and encourage young Albertans to pursue research careers.
6. To encourage increased collaboration in Alberta, Canada and elsewhere among investigators, research institutions, governments, other granting agencies and the private sector.
7. To continue to promote the development of medical research-related economic activities in Alberta, including commercialization of innovation.

(c) Proposed Investment Level

AHFMR will continue to invest the interest derived from the Foundation in a broad spectrum of basic research. Consistent with past practice, the investment in 1993/94 will be in the order of $30 million, a level which will ensure the long-term viability of the Foundation fund. The Trustees believe additions to the Foundation fund will be needed to meet the expanded mandate of AHFMR in technology transfer and health care areas.

(d) Organizations Involved

The biomedical and health research activity in Alberta is concentrated in the two major cities. In Edmonton, this activity is focused at the University of Alberta hospitals, the Cross Cancer Institute, the Royal Alexandra Hospital and other teaching hospitals in the urban area. In 1990, this research grouping was supported by over $38 million, obtained in successful competition from local, national and international granting agencies. AHFMR contributed over $12 million to this total.

In Calgary, activity is concentrated at The University of Calgary, the Foothills Hospital and the Tom Baker Cancer Centre. This research grouping attracted over $33 million in external funds in 1990, of which over $9 million was contributed by AHFMR.

AHFMR programs have concentrated on the recruitment and establishment of scientists to Alberta institutions, on the training of young scientists, on information exchange through travel and conferences, and research infrastructure. The operating support for the research activities — the actual project funding, is derived from a wide variety of national government and voluntary funding agencies. In rough order of importance, in terms of dollars contributed to provincial efforts, these include the Medical Research Council of Canada, Canadian Heart Foundation, National Cancer Institute, National Health Research and Development Program, Arthritis Society,

National Institutes of Health (USA). The AHFMR support has been widely credited with "priming the research pump" in Alberta, and of fundamental importance is the impressive growth in research funding attracted to the province in the past decade. Alberta is the only province to increase its proportion of funding from the Medical Research Council in the past three years. In addition, AHFMR investigators are attracting millions of research dollars from the pharmaceutical industry. This is a powerful testament to the provincial support of biomedical research.

The achievement of AHFMR researchers and their co-operation with other research groups is evidenced by the number of Alberta medical research teams included in the Federal Network of Centres of Excellence Program. The health related nodes are Bacterial Disease, Genetic Basis of Human Disease, Neural Regeneration, Protein Engineering, and Respiratory Health.

In the past 11 years, the Foundation has provided approximately $14 million in support to 30 investigators associated with these nodes. At the present time, on a yearly basis, the Foundation continues to provide in excess of $1 million in support of these researchers. The federal funds flowing to these health care nodes is expected to total $15 million while Alberta Technology, Research and Telecommunications is providing approximately $2.8 million in support.

(e) Key Program Elements

The Foundation provides grants and awards under a series of programs that fall into four major groupings:

- Personnel Awards and Establishment Grant — to assist in recruiting and establishing senior medical scientists in Alberta
- Training Program — to assist qualified medical scientists to further their training
- Research Support and Infrastructure Programs — to assist the medical research community acquire equipment and access to the most up-to-date information and technical developments in medical research
- Technology Commercialization Programs — to promote university/industrial collaboration in Alberta, stimulate technological innovation in Alberta and advance medical research in Alberta to the stage where private investors may provide seed capital. Continued expansion in technology transfer activities will accelerate the application and commercialization of medical research arising from Alberta universities and private sector companies.

AHFMR projects will continue to have major impacts on the Alberta health care system during the 1990s. The support provided by AHFMR to the Alberta nodes in the Network of Centres of Excellence will complement the Federal and Alberta Government support for these important centres.

It is expected that each dollar invested in Alberta medical research will continue to attract two dollars in additional funding by other organizations, ensuring a dynamic and diversified medical research program.

The principle impact of AHFMR will be on increasingly dynamic cadre of medical researchers and new medical knowledge, technology and practice to provide improved health care for Alberta's community.

8.6 Alberta Oil Sands Technology and Research Authority

(a) Background

By 1973, conventional oil production had become a major source of economic activity and government revenues in Alberta, but it was also evident that production capacity had peaked and was expected to decline by 500,000 barrels (80,000 cubic metres) per day by the year 2000. This shortfall would have to be made up by enhanced recovery and by heavy oil and bitumen production if Alberta were to maintain its position as the leading producer of liquid fuels in Canada, and if the country as a whole were to avoid dependence on imported oil.

The Alberta oil sands represented a very attractive solution since they were known to contain in excess of 1.7 trillion barrels (270 billion cubic metres) of bitumen in place. However, the only commercially-proven technology available for bitumen recovery was extraction from mined oil sand, which was applicable to only about 5% of the total resource and also involved high front end costs and long lead times.

Various companies were carrying out pilot tests in attempts to recover bitumen from the more deeply buried oil sands deposits, but these efforts tended to be fragmented and intermittent and were usually based on processes developed elsewhere for use under quite different reservoir conditions. It was evident that an expanded and sustained program of research, development, and field pilot testing would be required if the full potential of Alberta's oil sands resources were to be realized.

AOSTRA was established as a crown corporation by an Act of the Alberta Legislature in 1974 to stimulate such activities. It was intended that AOSTRA would carry out its field pilot projects jointly with industry to facilitate commercial use of technology arising from these joint projects. It was further intended that AOSTRA would make use of the research facilities and technical expertise of Canadian universities and research institutions wherever possible instead of establishing its own facilities, and would make efforts to access technology worldwide so that the best available technology could be used in Alberta.

In 1974 when AOSTRA was created technology existed to recover bitumen from the mineable oil sands for a total recoverable reserve of some 27 billion barrels. Today, through AOSTRA's effort, together with that of the private sector, recovery can be achieved from all three of Alberta's oil sands deposits for a combined producible reserve of in excess of 300 billion barrels. In addition, production costs have been reduced to half of their former value or less. At $7/barrel, they are now equivalent to the average cost of producing Alberta conventional crude oil. Industry has used this technology to commercialize development from the Peace River and Cold Lake deposit and is actively involved in recent advances in situ recovery from the Athabasca deposit.

Technology has also been advanced for recovery from Alberta's heavy oil deposits and for renewed recovery from abandoned light oil reservoirs. At the Joffre project, which has gone commercial, recovery has been increased 50% from a previously abandoned reservoir.

(b) Program Objectives

General

(1) To generate the technology that would enable the exploitation of Alberta's immense oil sands resources and their conversion to marketable products.

(2) To generate the technology for improved recovery from Alberta's heavy and conventional oil resources.

Specific Contemporary Objectives

(1) Demonstrate, in a commercial scale production pattern, the impressive results obtained for the Twin Well concept of steam assisted gravity drainage from underground access.

(2) Extend the concept of steam assisted gravity drainage using twin wells to surface access wells with application in all three major oil sand deposits.

(3) Demonstration of the ATP recovery technology for a mined oil sand application.

(4) Development of technology which will substantially reduce the cost of conversion of bitumen to transportation fuels.

(5) Maintain an ongoing effort in institutional research, information dissemination, training, technology handling and international exchange.

(c) Proposed Investment Levels

AOSTRA's proposed investment level for 1993/94 is $26.13 million, to be allocated to programs as follows in Table 8.6.1.

AOSTRA R&D investments have historically been leveraged by funds from industry. It is estimated that industry will contribute a further $29 million towards projects supported by AOSTRA. In view of the longer term nature of most of these projects, and the current economic state of the industry, it is highly unlikely that industry would invest in these projects on their own. Thus, withdrawal of AOSTRA support would result in the abandonment of $65 million of R&D effort.

In 1975 AOSTRA was initially funded by $100 million from the Alberta Heritage Fund. This was increased over the next 5 years to a total of $418.7 million. This long term commitment of funds enabled AOSTRA to enter into multi-year commitments which are essential for funding of field projects and for long term planning of research programs. In 1987, AOSTRA received its first GRF funding and over the next few years moved entirely to GRF funding as its Heritage funding was used up. In fiscal year 1991/92, AOSTRA effectively moved completely from a commitment to a cash flow budget. These changes severely limited AOSTRA's ability to make long term commitments and severely affected AOSTRA's operational ability and effectiveness. As a result of these actions, AOSTRA's year end commitments declined from $60.5 million in April 1987 to $17.7 million in April 1992 and its reserves against future commitments fell to essentially zero.

(d) Organizations Involved

AOSTRA has established an impressive network of organizations which collaborate actively in oil sands and heavy oil research. During the few years preceding the establishment of AOSTRA in 1975, the R&D in oil sands was limited to intermittent field tests by industry, often applying premature and inefficient recovery processes. There was

essentially no fundamental work underway on oil sands in Canadian universities.

The network is now well developed: 19 companies are involved with AOSTRA in sponsoring university research at eight Canadian universities; 12 companies along with CANMET co-operate with AOSTRA in sponsoring in situ recovery research at the Alberta Research Council; while nine companies, including most of the major oil companies and two foreign companies from China and Japan, are joint partners with AOSTRA in the Underground Test Facility Project. In addition, most other projects funded by AOSTRA are jointly funded, with industry usually taking an operating role. As indicated in Table 8.6.1 about 650 personnel will be directly employed on AOSTRA sponsored projects in 1993/94 fiscal year.

Table 8.6.1 AOSTRA 1993/94 Budget Estimate in $

	AOSTRA		Alberta	Canada	Other Contributors		Total	Direct Employment
	RSA	R&D	(3 Depts. & agencies)		(19 Industrial companies)	Other		AOSTRA
Institutional Research		4,025,000	2,110,000	1,036,000	1,764,000		8,935,000	186.5
Technology Handling	1,375,000				160,000		1,535,000	14.0
Training Activities	485,000		45,000				530,000	17.0
International Activities	200,000	200,000		60,000			460,000	5.0
Mining and Extraction		2,700,000			1,500,000		4,200,000	37.0
Technology Transfer & Commercialization		3,490,000			3,220,000		6,710,000	79.0
Underground Access		1,000,000		130,000	6,930,000	5,689,000[1]	13,749,000	80.0
In Situ Oil Sands		3,575,000			3,475,000		7,050,000	47.0
Carbonate Trend		150,000			150,000		300,000	6.0
Heavy Oil		400,000			3,200,000		3,600,000	26.0
Enhanced Recovery Con. Oil		2,370,000		500,000	5,540,000	625,000[2]	9,035,000	71.0
Environmental Projects		730,000	230,000	1,083,000	1,787,000		3,830,000	32.0
Bitumen Upgrading		1,725,000		1,425,000	1,500,000		4,650,000	48.0
Administration		3,700,000						47.0
Grand Total	2,060,000	24,065,000	2,385,000	4,234,000	29,226,000	6,314,000	64,584,000	648.5

1 Bitumen Revenue

2 Saskatchewan Government

A list of the distribution of organizations involved in AOSTRA programs is shown as follows:

Major integrated oil companies 11

Exploration and producing oil companies 19

Engineering and consulting companies 50

Provincial government departments and agencies 11

Federal government departments and agencies 3

Academic and educational institutions 21

International organizations 29

(e) Key Program Elements

Institutional

AOSTRA continues to support a number of institutional research initiatives to foster basic research activities and to promote development of technology towards field application. although it has been necessary to reduce its support of institutional research efforts. Remaining support will be directed to those projects which have strong industry support such as the Oil Sands Research Program conducted at the Alberta Research Council, university research contracts, and contracts with the Computer Modelling Group and the Petroleum Recovery Institute. In addition, support will also be given to the Strategic Research Program at ARC which seeks to move technology forward from basic research to field application.

Technology Handling

AOSTRA will continue to make technology available to industry so that it can proceed with exploitation of the resource. This will include all information in the public domain and in addition, the sale of technology developed by AOSTRA and its partners at fair market value. Minimal funds will be spent to maintain effective management of vital intellectual property.

Training

AOSTRA proposes to reduce its training programs but will maintain some effort to interest young people in careers in heavy oil and oil sands recovery and processing, and to assist them in obtaining the appropriate training.

International

AOSTRA will continue to use its strong technological position as a spearhead for international technology transfer and to promote the sale of Alberta goods and services in the international market place.

Mining and Extraction

Support will continue on the application of the successful AOSTRA-TACIUK process and other processes which reduce tailings problems and/or lead to significant cost reductions in producing bitumen from mined oil sands. Support will also be directed towards borehole mining as a means of increasing the mining area and towards dredging and hydraulic transport as a means of reducing mining costs. Demonstration of alternate extraction technology will be through special funding.

Technology Transfer and Commercialization

The principle thrust in this area will be in commercializing the AOSTRA-TACIUK process

(ATP) for cleanup of contaminated soils and for processing of oil shales, and in the commercialization of the very effective Steam-Assisted Gravity Drainage Process as practised from Underground Access. These technologies have shown excellent commercial potential and will be strongly supported by AOSTRA, both as a means of seeing early commercial projects in the province and to facilitate the sale of Alberta technology, products and services. Modest funds will also be expended in promoting other AOSTRA technologies such as Anti-Water Coning Technology (AWACT).

In Situ Oil Sands

The great success of the Steam-Assisted Gravity Drainage Technology with the resulting and sharp reductions in production costs, excellent recoveries and increased areas opened up for exploitation has prompted interest in application of this technology to deposits other than Athabasca and to its use from surface wells. AOSTRA intends to strongly support this effort and is thus proposing support of twin well operations from the surface-drilled projects in Peace River, Athabasca, Cold Lake and the heavy oil areas. Other expenditures would be in the abandonment costs for completed projects and in engineering support for all developments.

Heavy Oil

Proposed research will be directed toward continued support of the use of steam, combustion and immiscible carbon dioxide (CO_2) recovery as means of improved recovery of heavy oil. Increased use of recovery processes using horizontal wells will also be supported.

Enhanced Recovery of Conventional Oil

Support will continue for $C0_2$ miscible recovery projects as well as the use of bacteria to produce diverting agents and in further testing of the anti-water coning technology. The main strategic thrust, however, will be in the use of horizontal wells to greatly increase recovery from our depleted conventional reservoirs. Some funds will also be expended on basic research and engineering studies.

Environmental Projects

Environmental projects will concentrate on water treatment projects to permit and improve water recycle in situ recovery projects, on research into reducing tailings ponds at oil sands plants, and on $C0_2$ removal and disposal.

(f) Expected Impacts

(1) Renewed commercial development of Alberta's oil sands by reducing production and conversion costs below the price envelope expected for the products. This will be achieved by:

  (a) confirming and demonstrating production costs of $7/barrel

  (b) lowering of upgrading costs by $4/barrel and

  (c) increasing the market value of the Synthetic Crude Oil produced.

(2) Facilitating the growth of the scientific and technological base on which commercial development of Alberta's oil sands, heavy oil and enhanced oil recovery resources can proceed.

(3) A lower cost and expanded recoverable resource base.

8.7 Alberta Research Council

(a) Background

Mission:

Responding to the needs of the private sector, and supporting activities of the public sector, the Alberta Research Council will advance the economy of the province by . . .

- promoting technology development and application
- performing applied research
- providing expert advice, technical information, and scientific infrastructure.

It is the By the year 2000 vision that, the Alberta Research Council will be an internationally recognized technology corporation, valued as an important partner in the emergence of a globally competitive Alberta.

Today, ARC operates a major oil sands and hydrocarbon recovery research facility in Clover Bar and an oil sands separation pilot plant in Calgary, and has established its coal and hydrocarbon processing facilities in the Coal Research Centre at Devon. A new pulp and paper research program is being developed at the Clover Bar site. In Edmonton, the new facilities which opened in 1986, include a biotechnology pilot plant the only one of its kind in Canada, the Electronics Test Centre to support the telecommunications and electronics industries, manufacturing and testing laboratories which support the manufacturing sector, and forest products laboratory to assist Alberta's growing forest products industry. An environmental research group supports the sustainable development of Alberta's natural resources and diversification of the growing industrial base. In Calgary, the research emphasis is on advanced computing and manufacturing. Part of the environmental research activities are also located in Calgary.

Over the past five years, ARC has been working to strengthen its ties to industry. A Joint Research Venture (JRV) program has been established to accomplish this. Through the JRV program, ARC works directly with an industry partner to develop new or more advanced technologies for the industrial partner. Some key successes in this program have been the development of an automated manufacturing process for windows with Gienow Building Products resulting in a world class manufacturing facility that has created 50 additional jobs and exports which are penetrating the tough Japanese market. Work for Western Archrib Structures led to a process for the production of glue-laminated beams using spruce and pine from Alberta. This technology not only reduced Western Archrib production labour costs by 5%, but has also permitted replacing imported Douglas fir with local materials at a materials cost reduction of 15%.

The previous two examples, together with those that follow in the balance of this Research Overview, illustrate that research and development are contributing to both short and long term economic development of Alberta. The Alberta Research Council represents the "corporate" research arm for Alberta in a partnership serving both the public and private sectors.

(b) Program Objectives

Four principal goals have been established by the Alberta Research Council which will be the measure by which future programs and activities will be selected:

- Use advanced technology and develop new products and processes, unique to Alberta, that will enhance the competitiveness of resource industries, creating wealth and jobs.
- Ensure that economically and environmentally sustainable resource development will provide long term continuity to wealth-generating sectors of the economy.
- Establish co-funding and partnership arrangements with the private and public sectors to focus Alberta's human and technical resources on key economic priorities. By the end of the 1990s, it is planned that the Research Council will obtain 50% of its revenues from sources other than Provincial Government sources, thus on aggregate becoming a true joint venture between industry and government.
- Become an internationally recognized technology corporation contributing to the economic growth of Alberta by launching advanced technology companies into national and international markets.

Linkages are being strengthened with Alberta government departments promoting international technology trade, to ensure that the technology and expertise developed in Alberta are marketed world wide.

(c) Proposed Investment Levels ($ Million)

Table 8.7.1

Sector	Grant	Contract	Total
Manufacturing	8.98	10.21	19.19
Energy Petroleum & Bitumen	5.35	7.99	13.34
Environment	4.11	4.41	8.52
Agriculture	1.75	1.14	2.89
Energy — Coal	1.11	1.46	2.57
Transportation	0.94	0.73	1.67
Services	0.84	–	0.84
Health Technology	1.48	2.00	3.48
Energy — Natural Gas	0.50	0.63	1.13
Forestry	0.43	0.73	1.16
Science and Education	0.14	0.44	0.58
Total	$25.63	$29.73	$55.37

(d) Organizations Involved

The Alberta Research Council, as one of the largest and most diversified research organizations in Alberta, provides technology leadership in a number of key economic sectors. The president of the Research Council serves as chairperson of the Technology and Research Advisory Committee (TRAC), a key interdepartmental Alberta Government research co-ordination body. He also serves on various industrial-led R&D boards, agencies and committees, such as the AOSTRA/ARC/CANMET/Industry Policy and Program Committee which oversees a major oil sands consortium research program.

A large number of ARC scientists and engineers serve on an array of planning and co-ordinating bodies in Alberta's science community.

The concept of an Alberta Network for Manufacturing Innovation and Competitiveness (ANMIC) has been developed as part of the provinces manufacturing strategy. Its purpose is to improve the delivery multi-disciplinary assistance to Alberta firms. As a first step in establishing ANMIC, The LASER Institute, Alberta Microelectronic Centre and the Alberta Research Council have developed a common strategic and business plan for delivery of the appropriate services from the respective organizations to the manufacturing sector.

In addition to these organizational linkages, many of the programs of the Alberta Research Council are co-funded and co-managed with various Alberta Government departments and agencies, the federal government, and industry participants. Examples of these linkages are illustrated in the following table:

International linkages of the Alberta Research Council range from collegial relationships with scientists and engineers in many countries to collaborative multidisciplinary research projects. Co-operative research activities include work with organizations such as the Heilongjiang Academy of Sciences in China on the improvement of super absorbent polymers and development of industrial applications and with Eniricerche in Italy on filled hollow fibre membrane technology and coal technology.

(e) Key Program Elements

1. Manufacturing

- Objective:

  To improve the competitiveness of Alberta Manufacturers

- Activities:

  Assist with:
  - the development, adaption and adoption of advanced manufacturing technologies to improve efficiency

Table 8.7.2

Organizations Involved	ARC Programs*											
	1	2	3	4	5	6	7	8	9	10	11	12
ARC	X	X	X	X	X	X	X	X	X	X	X	X
AOSTRA	X	X	X		X							
Energy	X	X										
Environment		X		X						X		
Education												X
Health											X	
Transportation and Utilities		X							X	X		
Forestry, Lands and Wildlife		X				X		X				
Agriculture							X	X				
Industry	X	X	X	X		X		X	X	X		
Federal Government		X	X				X					

*Programs: 1.Clean Fossil Fuels; 2.Geological Survey; 3.Oil Sands Technology; 4.Land Reclamation; 5.Strategic Oil Sands; 6.Forest Products; 7.Soil/Land Resources; 8.Wildlife Technology; 9.Transportation Engineering; 10.Surface Water Engineering; 11.Health Science; 12.Education

- application of "intelligent" computing technologies to manufacturing
- the development of new and improvement of existing products
- product testing

- Expected Impact

- new products for commercial use
- improved in-plant technologies
- increased revenues from processing new materials into consumer products will be increased
- Operating costs for Alberta industry will be reduced.
- Improved competitiveness and diversification will develop Alberta's economy.

2. Energy — Petroleum and Bitumen

- Objective:

Economically competitive technologies for the extraction, upgrading and utilization of Alberta's vast hydrocarbon resources.

- Activities:

In situ recovery program:
- develop improvements in existing extraction processes
- find and evaluate potential new breakthrough technologies
- fundamental understanding of recovery processes

Upgrading:
- develop new upgrading technologies to reduce costs and increase yields

Surface mining:
- provide pilot plant support for extraction processing
- laboratory evaluation of processes

Resource Evaluation:
- regional characterization of oil, gas, oil sands and heavy oil resources
- reservoir characterization and analysis
- provide analytical services for both primary resource and process evaluations

- Expected Impact:

- Major investments in new commercial projects such as OSLO or new in situ extraction plants will proceed on the basis of improved technologies.
- Alberta companies will have technologies to export to countries with heavy oil and bitumen resources.
- Commercial in situ recovery plants at Peace River and Cold Lake will continue to operate.

3. Environment

- Objective:

Integrate environmental enhancement with sustainable economic development.

- Activities:

Energy Sector:
- characterization and treatment of oil sands sludges
- develop strategies for deep well injection of liquid waste
- develop technologies for disposal of drilling wastes
- develop technologies for characterization and remediation of industrial waste disposal sites
- develop air quality assessment, monitoring and modelling methodologies
- develop reclamation technology for land disturbed by coal mining

Land Soil and Water Resources:

- develop and supply information technologies and data bases
- disseminate information to support resource management for new developments and resources management
- develop an integrated groundwater information and management system
- create and commercialize geographic information systems for natural resource information management and modelling

Pulp and Paper:

- develop technologies for effluent and sludge treatment
- develop automation systems for improved control of effluent treatment ponds
- improve de-inking technologies so more used paper stock can be recycled

- Expected Impact:
  - Reduced environmental impact from the primary resource production sector; primarily oil, coal, and pulp and paper industries
  - Improved land, soil and water resource utilization
  - Better information base for informed decision making by industry, government, and regulatory agencies
  - Reduced operating costs for industry, thereby improving economics and competitiveness leading to sustainable resource development

4. ***Agriculture:***

- Objective:
  - Develop techniques for pilot plant level production of biological inoculants, insecticides and vaccines
- Activities:
  - Pilot plant scale testing of fermentation processes
- Expected Impact:
  - Economics for the agricultural industry will improve.
  - A viable biotechnology manufacturing industry will be established in Alberta.
  - Alberta will produce non-food agriculture products for export

5. ***Energy — Coal:***

- Objective:

  Develop advanced coal technologies leading to sustainable use of this resource in economically and environmentally acceptable processes

- Activities:
  - Develop "clean coal technologies" by improving gasification, liquefaction and combustion processing
  - Develop techniques for pipeline transportation of coal slurries
  - Improve and commercialize coal based agglomeration technologies for clean-up of oily wastes
  - Geological mapping and resource evaluation in Foothills Coal belt
- Expected Impact:
  - "Clean coal technologies" and more cost efficient transportation of coal will open up new markets; both locally, in Ontario, and internationally. Alberta's coal resources will be developed.
  - A large potential market exists for cost efficient technologies for cleaning up oily spills, oily wastes, and remediating contaminated soils.

6. Energy — Natural Gas:

- Objectives:
  - To develop new processes and products that will add value and expand the markets for Alberta's natural gas resources
- Activities:
  - Research on electrolytic or catalytic conversion of natural gas to value added products such as methanol, isobutylene and ethylene
- Expected Impact:
  - Most natural gas is now sold as low value heating and transportation fuel. Commercial technologies for conversion to higher value products will greatly expand the markets into petrochemicals and lead to additional industrial growth.

7. Transportation:

- Objectives:
  - Provide an improved highway management system; assessment of environmental effects on pavement cracking and breakup; improved pavement repair and design procedures
  - Provide testing and certification of fuels and lubricants for industry; fuel use surveys
- Activities:
  - Develop technologies that assist in design, evaluation, operation and management of transportation facilities and infrastructure
  - Develop methods to evaluate performance of liquid fuel, lubricant and petroleum products and ensure these meet changing performance requirements because of environmental concerns; provide quality insurance evaluation of petroleum testing laboratories
- Expected Impact:
  - Efficiency will increase in allocation and use of resources in highway construction, with savings of over $2 million/year. This will mean more cost effective maintenance of existing highways.
  - Alberta's high quality fuel standards will be maintained.

8. Health Technology:

- Objectives:
  - Develop biopharmaceutical compounds and the scale up technologies for their production; transfer technology to the private sector
- Activities:
  - Provide infrastructure support, scale up and manufacturing capability for chemical based biopharmaceutical compounds and large scale carbohydrate chemistry production
- Expected Impact:
  - Success will lead to a new biopharmaceutical industry in Alberta and technologies for world wide exploitation

9. Forestry:

- Objective:
  - Work in partnership with industry to deliver R&D and testing to support forest management and integrated resource planning, including forest products and wise management of Alberta's wildlife and wildlife habitat
  - Work in partnership with the BCTMP pulp and paper industry to minimize the environmental impact of the industry and promote its sustainable development
- Activities:
  - Operate an accredited testing laboratory for wood products
  - Operation of a scale up laboratory for wood structural panel development
  - A new research program in support of the BCTMP pulp and paper industry has been started
  - Continue research on humane trap development
- Expected Impact:
  - Development of improved wood and wood composite products will lead to production of more value added components from Alberta's forest resources.
  - Improved forest management practices will lead to better multi-party usage of the resource and help to maintain a sustained supply of lumber and wood fibre products.
  - Improved trapping technologies will help to maintain the traditional markets for furs, particularly in Europe where the industry is facing an embargo.
  - Improved environmental technology for the BCTMP producers will make the industry more economic; leading to further investment in the industry and greater acceptance of the industry by the public

10. Science and Education:

- Objectives:
  - "Gatekeeping" to identify new science and technology thrusts and ensure that these get transferred to Alberta industry
  - Increase public and secondary school level of awareness of the impact of technological change
- Activities:
  - Technology line responds to enquiries on research and development activities and ARC services
  - Teacher's Research Experience program provides opportunity for school teachers to participate in ARC projects and to increase their awareness of current R&D trends
- Expected Impact:
  - Alberta industry remains leading edge and competitive.
  - Public is aware of the impact of technical change.
  - The quality of science teaching in Alberta will be improved.

8.8 Alberta Culture and Multiculturalism

(a) Background

The department, as a steward of our historical resources and culture, has a mandate to promote cultural activities and heritage projects and education within the Province of Alberta in three distinct areas — the arts, multiculturalism and historical resources/ museums. While some studies are conducted or sponsored in the first two areas, it is the Historical Resources Division where the majority of departmental research and development takes place. Research is a critical element in curatorial care of collections (whether in situ or in museums), in interpretive programming and in facility development. A significant portion of the division's assets are devoted to specialized historical, archaeological, paleontological, architectural or museological research.

Aside from instilling local pride and serving as hands-on educational centres for Albertans, provincial heritage facilities in Alberta have stimulated cultural tourism and assisted in diversifying, decentralizing and strengthening the economy.

These museums, interpretive centres, and historic sites have provided an excellent return on the taxpayers' investment by generating new service sector revenues equivalent to their capital costs in periods of three to seven years.

For the last four years, an average of 1.3 million visits have been recorded per year at this network of provincial attractions. The local economic impact of related visitor spending is approximately $20 million annually, with another $6.5 million annually expected when three new facilities open in the near future. The impact of the Royal Tyrrell Museum on the local economy averaged $8.3 million annually over the past four years. Overall expenditures in Alberta by non-local visitors to these sites average nearly $50 million annually.

(b) Department Objectives

The Historical Resources Division is charged to preserve, study and interpret evidence of Alberta's human and natural history and provide public education about our heritage. In addition, the activities stimulate heritage tourism through:

1. a network of eighteen museums, interpretive centres and historic sites which are provincially developed and operated
2. resource management programs associated with the Environmental Impact Assessment process, and
3. public assistance programs to help community efforts in preserving our heritage.

Table 8.8.1

General Revenue		Regulated Fund (millions)	Lotteries Funding	People
R&D	**RSA**	**RSA**		
$4.45	$15.79	$2	$3.35	305 plus 60 contractors and grantees

(c) Proposed Investment Level

The proposed investment level is $4.45 million for R&D and $15.79 million in related scientific activities such as museum services.

Impact of Cutbacks

Two major problems exist for the Historical Resources Division in the currently constrained fiscal environment: manpower and recapitalization. While given excellent facilities, manpower to operate provincial heritage facilities and programs has always been tight and impacted further with repeated budgetary reductions. It has also been somewhat difficult to obtain monies to replace aging exhibits, upgrade older buildings and purchase certain new replacement equipment.

The 5% budgetary reduction last year did result in some program changes and job loss, although the department was able to off-load some of the reductions to Lotteries funding and Regulated Fund offsets. Approximately seven full time equivalencies were lost. One of our attractions (the Ukrainian Cultural Heritage Village) was reduced from a year round to a seasonal operation, the Glenbow Museum took a 5% cut to its operating grant, and approximately $1 million in offsets were arranged (divided equally between Lotteries and Regulated Fund).

(d) Organizations Involved

The department works on a regular basis with numerous other provincial government agencies, the federal and municipal departments, several universities, and similar museums/research institutions world wide. For example, the Dinosaur Project involved co-operation between China, Canada, Alberta and the Ex Terra Foundation. Significant scientific partnerships exist with the National Museum of Natural Sciences (Canada) and the Chinese Academy of Science on paleontological research.

(e) Key Program Elements

Heritage Facility Development

Over the last decade, Alberta has been a leader internationally in the rapid development of a network of heritage attractions. Not only are these hands-on educational institutions that provide meaningful and memorable educational experiences, but they also act as major tourism attractions. On average nearly one new museum, interpretive centre or historic site has been opened each year since 1980, with a value averaging $10 million per facility. In total, the visitor expenditures to the government operated facilities have a provincial economic impact approaching $50 million annually, which can be increased substantially when considering the added effect of the community museums system. The primary role for the work of the Historical Resources Division is to educate, thus making Albertans more aware and appreciative of their colourful and distinctive heritage. School programming is an important aspect of the operation of all provincial heritage facilities. Departmental publications reach a broad audience, and museums are used by a wide cross section of Albertans.

However, beyond the socio-educational benefits, historical resources development has yielded major economic spin-offs for Alberta. The network of 20 provincial heritage facilities provides well in excess of $20 million annually in regional tourism, and with the system of over 100 community museums, draws approximately five million visits per year. All museum visitors use local services in their trips.

The department's work in the encouragement of the restoration of heritage buildings has also been significant, adding an aspect to the construction industry that is labour intensive and environmentally friendly. For major areas, such building conservation has also meant low cost urban revitalization and the creation of districts of character (e.g. Old Strathcona, Fort MacLeod, Stephens Avenue Mall, etc.). In turn, this has resulted in colourful areas of attraction with increased business and tourism.

In summary, historical resources provide us with tangible evidence of our distinctive and colourful past, which can make history come alive for both the student-visitor or scientist alike. They give us pride as Albertans, add to the quality of our lives, and also function as attractions to non-Albertans, who wish to know who we are and where we come from. This area has provided both strong socio-educational and economic returns on the taxpayers' investment.

Paleontological Research

The Royal Tyrrell Museum is the largest dinosaur facility in the world, and several of its scientists are establishing international reputations. This credibility has also brought a host of research exchanges and displays including work with China, Japan, Australia, and the United States.

The recent Gakken Project in Japan utilized 24 Alberta built dinosaurs in a special show viewed by one million Japanese within two months. This was Alberta's largest ever direct exposure of any kind in Japan. The show was a great success for its corporate sponsors, and for its contribution, the Tyrrell Museum received some $2 million worth of exhibit specimens, various computer materials, and further recognition in Japan.

The Dinosaur Project: China-Canada-Alberta-Ex Terra is a multi-year, multi-million dollar research and exhibition programme involving several partners. The research phase produced some 60 tonnes of fossil materials from excavations in China and Alberta. More than a dozen new specimens of dinosaurs or fossil reptiles were discovered for the first time. In addition, many of the specimens collected were among the best of their kind ever found. Over 100 research papers have already been produced or are underway relating to the project. It has received media coverage in the New York Times, National Geographic, Omni, Discover, Newsweek, Natural History, CBC Journal and PBS Nova. The exhibition now under development will tour the world and be the largest such show ever seen. Moreover, the effort is building Alberta's ties with China, a nation containing one-third of the world's population.

Smaller research efforts are also occurring across Alberta with excavations at Dinosaur Provincial Park near Brooks, at Devil's Coulee Dinosaur Egg Site near Raymond, in the Drumheller area, the Crowsnest Pass, and near Grande Prairie.

Archaeological Research

This area has had a major scientific exchange with China, exploring early man migrations from the old world into the new world, and specifically through Alberta. Field excavations are continuing to study what is believed to be Alberta's early migration corridors.

Much of this unit's research is related to Historical Resources Impact Assessments, where sites with archaeological potential are threatened by development (e.g. sub-divisions, gas pipelines, forestry activities, etc.). In these cases, staff work with private

consultants to glean whatever scientific knowledge is available from the subject areas and to intervene if appropriate. This research is mandated by the Historical Resources Act and is continuous and widespread and will ensure that archaeologically important sites are not destroyed.

Natural History Research

The Provincial Museum of Alberta is responsible for the development of collections reflecting the province's natural history, and the public interpretation of associated themes. Behind each display seen in the museum, extensive field and lab research has occurred. This again, is both continuous and widespread and will ensure that the people of Alberta have a record of their natural history for their education and enjoyment.

Other Human History Research

Both the Historic Sites & Archives Service and the Provincial Museum of Alberta are involved in a wide variety of human history research across the province on a continuous basis. Any public display in the departmental facilities, and all publications, are backed by extensive research. As previously mentioned in the archaeological section, this too is linked to the Historical Designations — the legal protection of sites of heritage significance. Assistance is also provided to members of the public engaged in their own heritage research.

Economic Impact of Provincial Heritage Facilities

Each year thousands of visitors surveys are collected at provincial museums, interpretive centres, and historic sites to obtain a profile of the people utilizing the sites, getting their opinions on programs and facility design, and examining their spending patterns. Alberta's survey is among the most extensive of its kind in Canada.

8.9 Alberta Economic Development and Trade

(a) Background

Over the past two decades, Alberta's increasingly industrialized economy has realized substantial gains in growth and development. From 1971 to 1991, the size of the Alberta economy more than doubled in terms of real Gross Domestic Product.

Manufacturing and upgrading of primary resource products helped to diversify the economy during the 1970s and 1980s. However, investment in major capital projects, which has led much of the economy's growth in the past two decades, may not occur to the same degree in the foreseeable future. It is likely that a more broadly-based economy, with an increasingly diverse range of internationally competitive small and medium-sized enterprises, may prove to be a key engine for future economic growth.

In terms of real value of shipments, Alberta's manufacturing base has more than tripled in size since 1970. Alberta's manufacturing sector consists primarily of value-added resource products, such as petrochemicals, forest products, processed foods and refined petroleum products, and industrial goods, including oil and gas field equipment, fabricated metal products, transportation equipment, electronic products and construction materials.

A key element of Alberta's diversification strategy has been to broaden the province's economic base by encouraging

manufacturing and the further upgrading of resources. This has helped to diversify the economy by expanding the product base above and beyond traditional resource commodities to higher value-added products.

The linking of new, advanced and knowledge-intensive technologies with our traditional manufacturing industries is seen as a major advantage Alberta has over many of its foreign competitors. The application of these new technologies to manufacturing will improve product quality, reduce costs, increase value-added processing, and enhance environmental protection. This will result in increased competitiveness in global markets.

The importance of Alberta as a trading province continues to expand, as the value of international exports reached $17.8 billion in 1991. International exports accounted for about 24% of Alberta's GDP in 1991. In addition, it is estimated that as many as 250,000 Albertans are directly or indirectly employed as a result of international trade.

(b) Department Objectives

Departmental Mission Statement: "To co-ordinate and implement the economic development and diversification strategy of the Government of Alberta."

The overall investment and economic development strategy of the department encompasses several key elements and programs. These include:

- planning and policy formulation,
- business counselling and development,
- manufacturing and industry development,
- business finance development,
- investment promotion, and
- export/trade development.

The activities of the department are primarily focused on the diversification of the Alberta economy and improving business competitiveness. These activities are aimed at strengthening the private sector through business and entrepreneurial development, trade and investment promotion, and support to resource upgrading and advanced manufacturing. To support this mission, the department works closely with other line departments and levels of government, as well as with the private sector, in co-ordinating and integrating its various activities.

(c) Department's Estimated R&D Investment Level (1993/94 Fiscal Year)

Statistics Canada definitions were used in determining Economic Development & Trade's 1993/94 anticipated expenditures on research and development and related scientific activities (R&D/RSA). These definitions of R&D and RSA, which in addition to the natural sciences also include activities related to the humanities and social sciences, are much broader than definitions applied in the past. The result is that more of the department's activities now fall under the designation of R&D/RSA.

As studies and other related work to be undertaken in the 1993/94 fiscal year have not yet been fully identified, it is assumed that budget allocations to R&D/RSA will likely not change significantly from the 1991/92 fiscal year, and will therefore be in the range of $2.6 million (once again, based on the broader Statistics Canada definitions of R&D/RSA).

A breakdown of anticipated 1993/94 departmental expenditures on R&D and RSA follows:

- Policy & Planning Division — $1,270,000;
- Small Business & Industry Division — $625,000;

- Business Finance & Investment Division — $200,000;
- Trade Division — $100,000;
- Finance & Administration — $335,000; and
- Grants to Educational Institutions — $70,000.

Overall, the majority of the department's research-related activities are in the area of RSA. However, using the Statistics Canada definition of R&D, there are a few activities that fall within this area as well.

(d) Organizations Involved

Economic Development & Trade's involvement primarily lies in the business development potential with new and emerging technologies, processes and products. It is in these areas that the department is most actively involved in terms of related expenditures and planning.

Economic Development & Trade chairs the Deputy Ministers' Committee for Co-ordination of Economic Development, Diversification & Trade. The Committee provides a focal point for the interdepartmental co-ordination of major economic initiatives of the Alberta Government. Department personnel work closely with all Government departments and agencies in matters related to diversification, competitiveness, and trade and investment promotion.

The department's close working relationship with Technology, Research & Telecommunications and the Alberta Research Council (ARC) is designed to facilitate the establishment of a strong advanced technology sector and to provide technology support to other business sectors. The Industrial Research Assistance Program (IRAP), jointly supported by the ARC and the National Research Council (NRC), is an important delivery mechanism for providing technical assistance to specific companies.

The 10 regional offices of Economic Development & Trade provide basic business support to companies in their respective regions. This includes the provision of business counselling services and information on economic opportunities and government programs.

The Western Economic Diversification (WED) Program of the Federal Government provides financial support to industry, and Economic Development & Trade works closely with WED in helping companies access this program. Other federal programs are also utilized on a project-by-project basis.

(e) Key Program Elements

Economic Development & Trade's involvement in related scientific activities reflects the changing technical needs of various economic sectors. For 1993/94, the following will likely be the principal program elements:

- quality management program
- manufacturing expertise missions
- assistance to companies, with technical components provided by Alberta Research Council personnel
- through the department's involvement in the Alberta Action on Waste initiative, financial and other forms of assistance are provided to support Alberta businesses in taking advantage of manufacturing opportunities in waste management, waste minimization, recycling and environmentally-friendly products and
- under the Western Economic Partnership Agreement (WEPA) the department will

provide support to community-based organizations, business associations, entrepreneurs and businesses. Community-based initiatives will encourage entrepreneurial development, improve access to business information, encourage local investment in local projects, and support local economic planning. Competitiveness initiatives will encourage Alberta businesses to identify, acquire and implement new technology for new products and processes, adopt quality management practices, and develop export markets. Total funding for the program, which will be cost-shared with the federal government, is $24 million over three years. This funding, or portion thereof, has not been included in the department's estimated 1993/94 R&D/RSA expenditures, as the funds are given directly to communities and businesses, who will then spend the money on scientific-related or other activities.

(f) Expected impact

Competitiveness is often defined as being "cost-based," with labour, transportation, raw materials and other input costs being the key determinants. While these are important considerations, Alberta's ability to compete is also strengthened through technological innovation and other improvements aimed at increasing productivity. Moreover, the quality of the products or services being offered is becoming increasingly important to competitive success. Once again, the department's program, service and policy initiatives are primarily focused on the diversification of the Alberta economy and on improving business competitiveness in these and other areas.

The department sponsors or financially support studies pertaining to the economic or industrial development aspects of research-related activities. For example, the department is currently engaged in a study with the other Western provinces and the federal government to identify existing capabilities, strengths and expertise within Western Canada's environmental industries. The study will also recommend possible approaches for greater inter-regional co-operation in areas such as business and trade development, R&D and technological innovation.

8.10 Alberta Energy

(a) Background

The objective of the Department of Energy is to facilitate orderly development and upgrading of Alberta's energy resources to obtain optimal economic return for Albertans. This is achieved through expanded industrial activity with minimal impact on the environment or resource development and use.

The resources overseen by the Department of Energy include remaining established reserves (1991) of 410 million cubic metres (2.6 billion barrels) of light and medium crude oil, 58 million cubic metres (365 million barrels) of heavy oil, 502 million cubic metres (3.2 billion barrels) of crude bitumen, 1,631 billion cubic metres (57.9 trillion cubic feet) of natural gas and 32 billion tonnes of raw coal. The department is also the steward of the provincial crown owned industrial and metallic minerals.

In 1991, Alberta's energy industry employed approximately 78,000 people, and the extraction and sales of these resources contributed revenues of $16 billion to Alberta's economy.

If the Alberta energy industry is to continue to be a major wealth-generating component of the Alberta economy, it is essential to continue developing and applying new technologies. These new technologies are needed to meet increasing environmental standards, to maintain or increase the energy industry's competitive position, and to upgrade Alberta's energy resources to higher value-added products.

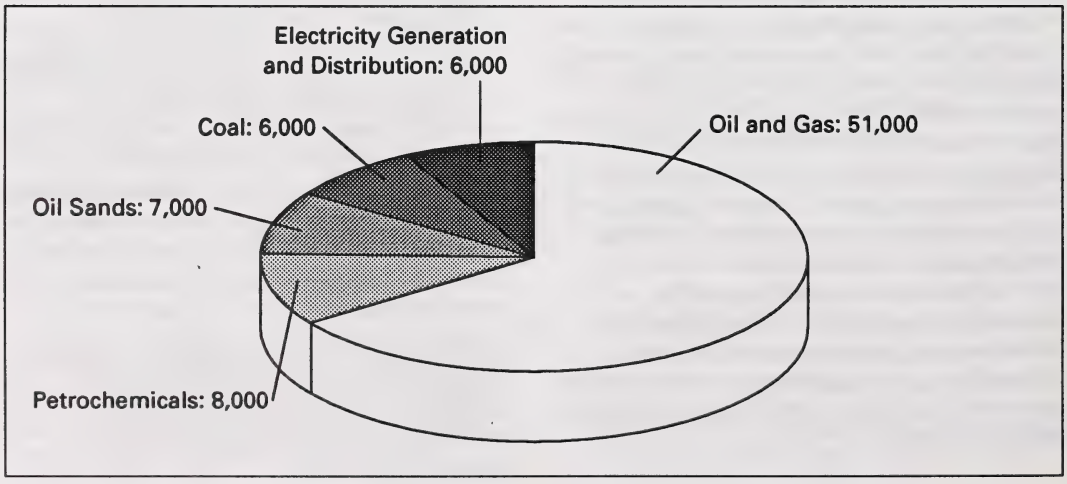
As well, many of Alberta's resources have not been fully explored, evaluated and exploited. For example, the renewable solar and wind energy resources of southern Alberta show promise of being used on a large scale. Also, the presence of substantial amounts of hydrogen in Alberta's sour gas resources needs considerable investigation. This could allow recovery of hydrogen, which is a highly valued product that is being used increasingly in the energy industry. In addition, Alberta is believed to possess numerous deposits of commercially valuable minerals, but they have not been well explored or characterized. The development of all these non-renewable, renewable and non-energy resources can contribute enormously to the diversification and growth of Alberta's resource industry.

Compared with the $16 billion annual contribution these resources made to Alberta's economy, the research investment proposed by the Research and Technology Branch for 1993/94 to help maintain or make this contribution grow is $9.08 million. This represents 0.056 per cent, or approximately 1/2000th, of the annual resource revenue.

(b) Department Objectives

To facilitate the optimal recovery of these resources by industry for the benefit of all Albertans, the Department of Energy has established the following research and development objectives:

Figure 8.10.1 Employment in Alberta's Energy Industry



- Through co-management with the Alberta Research Council, ensure publication by the Alberta Geological Survey of maps, supporting data and related research to stimulate exploration and development of Alberta's natural gas, oil, oil sands, coal, industrial and metallic resources by the private sector and in support of environmental objectives.
- Through a coal research program, develop clean coal-burning technologies for the long-term, environmentally acceptable and safe use of coal as the fuel of choice for generating electricity.
- Through a hydrogen research program, develop technologies for producing, transporting and using hydrogen to upgrade Alberta's energy resources.
- Through a renewable energy research program, develop technologies for exploiting Alberta's solar, wind and hydro resources.
- Through an energy efficiency program, develop and demonstrate technologies, and promote practices that will ensure efficient use of energy in residential, commercial and industrial settings.
- Through a mineral development agreement with the federal government, characterize and exploit Alberta's non-energy mineral resources and maintain an up-to-date geological data base and assessment of Alberta's earth resources.

Not included in Alberta Energy programs are large-scale hydro developments, nuclear energy, oil and oil sands research. Large-scale hydro is perceived to be a mature technology that has limited application in Alberta in the foreseeable future, while nuclear energy is believed to be unnecessary in a province having abundant and diverse energy resources. Oil and oil sands research are excluded because they are the mandate of the Alberta Oil Sands Technology and Research Authority.

(c) Impact of Budget Reductions

The budget available for coal research has been declining since 1989/90. This limited funding was a significant contributing factor in the rejection by the department of proposals for eight promising research projects in 1992/93.

Similar rejections have occurred in the Hydrogen Technology program, but they have been kept to a minimum by reducing the department's funding contributions below those requested by other funding partners. This has allowed the department to participate in most of the proposals brought to it for approval.

(d) Other Organizations Involved in the Department's Programs

In addition to the funding provided by the department, other organizations, preferably industry, contribute to its programs. These organizations are shown in Table 8.10.4.

(c) Proposed Investment Level

1. Proposed Investment for 1993/94

   The research investment proposed for 1993/94 is shown in Table 8.10.1.

It is important to note that Alberta Energy's research and development investment is leveraged as much as 4:1 by industry, and some other provincial and federal government funds. Also, the department's proposed investment for 1993/94 is expected to support 39 man-years of R&D and related scientific activity in various organizations and private companies in Alberta, in addition to 12 man years of professional and support staff in the Department.

2. 1992/93 Funding Contributions

During 1992/93, the funding contributions by all parties participating in projects that were partly funded by the Alberta Government are shown in Table 8.10.2.

3. 1992/93 Manpower Allocations

The manpower allocations associated with the 1992/93 funding contributions are shown in Table 8.10.3.

Also, Alberta Energy collaborates closely with several provincial, national and international organizations in establishing priorities and developing and funding programs.

Some of these agencies are listed below.

Alberta Geological Survey

Alberta Chamber of Resources
Alberta Research Council
Alberta Environment
Alberta Forestry Lands and Wildlife
Alberta Transportation and Utilities
Alberta Oil Sands Technology and Research Authority
Alberta Energy Resources Conservation Board
University of Alberta
The Coal Association of Canada
Canadian Society of Petroleum Geologists
Energy, Mines and Resources, Canada
Mineral Exploration Group
Canadian Association of Petroleum Producers
Individual private companies

Table 8.10.1 Proposed Investment In 1993/94 ($ Million)

Programs	Research & Development (R&D)	Related Scientific Activities (RSA)	Total	Manpower Projections
(man-years)				
Coal & Emissions	1.50	0.15	1.65	6.3*
Hydrogen Research	1.00	0.10	1.10	4.2*
Renewable Energy Initiative	1.00	0.10	1.10	4.2*
Energy Efficiency	1.00	0.10	1.10	4.2*
Mineral Development	1.75	0.25	2.00	7.7*
Alberta Geological Survey	0	1.37	1.37	5.0*
Administration	0	0.83	0.83	7.9#
TOTAL	**6.25**	**2.90**	**9.15**	**39.1**

* Based on 60% of the budget @ $65/hr for research professional man-hours

Based on 80% of the budget @ $35/hr for administrative man-hours

Coal Technology

Alberta Office of Coal Research and & Technology
National Advisory Council on Coal Research
The Coal Association of Canada
Canadian Electrical Association
International Energy Agency
Governments of Japan and Germany
Individual private enterprise companies

Hydrogen Technology

Alberta Hydrogen Technology Steering Committee
Hydrogen Review and Selection Committee
Hydrogen Industry Council
Individual private enterprise companies

Renewable Energy Initiative

Alberta Office of Renewable Energy Technology
Individual private enterprise companies

Mineral Development Program

Alberta Geological Survey
Institute of Sedimentary Petroleum Geology
Alberta Chamber of Resources
Department of Western Economic Diversification
Alberta Research Council
Energy, Mines and Resources Canada

Also, as a matter of principle, the Department of Energy does not provide funding for capital

Table 8.10.2 Funding Contributions 1992/93 ($Thousand)

Programs	A/Energy	Other Gov.	Industry	Total
Alberta Geological Survey	1,518	3,293	234	5,045
Coal	2,067	3,006	1,886	6,959
Hydrogen	824	432	892	2,148
Renewable Energy Initiative	774	114	20,815	21,703
Mineral Development	1,123	1,000	-	2,123
Total	6,306	7,845	23,827	37,978

Table 8.10.3 Manpower Allocations 1992/93 (Man-Years)

Programs	University	Governments Institutions	Industry	Total
Alberta Geological Survey	0.0	45.8	0.0	45.8
Coal	0.1	6.8	9.9	16.8
Hydrogen	2.9	2.3	3.8	9.0
Renewable Energy Initiative	0.0	0.5	4.0	4.5
Mineral Development	0.0	9.8	2.5	12.3
Total	3.0	19.4	20.2	88.4

purchases. This is done to avoid any issues arising over ownership. The department does provide funding for research and manpower components of projects, but requires that contractors provide funds for capital expenditures.

(e) Key Program Elements and Impacts

Alberta Geological Survey

The Alberta Geological Survey (AGS) is the custodian of coal, oil and minerals geoscience information for the province. A significant proportion of Alberta's economy is dependent on earth resources: "if you can't grow it, you've got to mine it." Geoscience information is needed to make decisions on where to explore, where to mine, how to mine ("mining" in this context includes oil and gas recovery), how to protect the environment and how to manage mineable resources to the optimum benefit of the province. Almost all jurisdictions on earth have a geological survey that provides geoscience information as part of the infrastructure provided by government to stimulate economic development. The AGS provides this infrastructure in the province.

AGS products are used by various levels of government, industry and the general public. The AGS achieves its mandate by adding

Table 8.10.4 Organizations Involved

	Programs				
Organizations Involved	**Coal**	**Hydrogen**	**Renewable Energy & Energy Efficiency**	**Mineral Development**	**Natural Gas**
Alberta Research Council	X	X	X	X	(X)*
Alberta Geological Survey	X			X	
Energy, Mines and Resources Canada (CANMET)	X	X	X	X	(X)*
Western Economic Diversification	X	(X)*		X	
The Coal Association of Canada	X				
International Energy Agency	X				
Hydrogen Industry Council		X			
Alberta Chamber of Resources		X		X	(X)*
Geological Survey of Canada				X	
Universities/Industry	X	X	X	X	(X)*
Canadian Electrical Association	X		X		(X)*
Gas Metropolitan Inc.					
Gas Technology Centre, Quebec					(X)*
Industry, Science and Technology Canada					(X)*

* To be defined.

value to information on the province-wide or regional level. AGS and the private sector play complementary roles. The private sector meets very specific needs, addressing very specific business opportunities, geographic areas and commodities.

Coal Technology

The objectives of the coal research program are:

- to minimize the environmental impact of coal production, transportation and use in Alberta and elsewhere, with particular emphasis given to global warming
- to enhance the competitiveness of Alberta coals in domestic and international markets and
- to develop new uses for Alberta coals.

The program is developing and demonstrating environmentally acceptable clean-coal technologies for electricity generation, and technologies for using coal as a source of value-added products, such as carbon fibres. With appropriate support by industry, the program will continue developing and applying advanced technologies for coal exploration, mining, preparation, upgrading and transportation. Several of these developments are occurring within the Western Canadian Low-Sulphur Coal to Ontario Program.

These activities will assist a viable and well-established coal industry to continue and possibly expand, while demonstrating that coal can be as environmentally acceptable as any other fossil fuel. Approximately 2 400 people are employed directly by Alberta's coal producers, and up to 6 000 people are employed directly and indirectly by all aspects of an industry that contributed revenues of $500 million to Alberta's economy in 1991. These revenues are derived partly from export sales and from the use of coal in Alberta to produce reasonably priced electricity.

Hydrogen Technology

Hydrogen is being used increasingly to upgrade crude oils and bitumen to produce transportation fuels, and the processes that use it are being continually improved to reduce production costs and improve productivity. Although the addition of hydrogen converts bitumen valued at $8 a barrel to synthetic crude oil valued at $20 a barrel, less expensive, more efficient methods for producing hydrogen are needed by industry.

Thus, the objectives of the hydrogen research program are:

- to upgrade the hydrogen content of Alberta's fossil fuels so they can meet increasingly stringent environmental protection requirements
- to position Alberta as a leader in the development of hydrogen technology and
- to strengthen Alberta's position as the largest producer and consumer of hydrogen.

The current hydrogen research program is investigating advanced or alternative hydrogen production technologies, production technologies that work synergistically with those being developed in the coal research program, hydrogen separation technologies, large-volume hydrogen storage, transportation and distribution of hydrogen, optimum end-uses of hydrogen, and materials and safety technology.

Currently, the program is placing particular emphasis on the production of hydrogen from Alberta's abundant supplies of hydrogen sulphide contained in sour natural gas. If a commercial process can be found for dissociating hydrogen sulphide into its two components — hydrogen and sulphur — not only will two valuable commodities be produced from an otherwise hazardous chemical, but no other environmental emissions are likely to be formed as by-products.

The availability of lower cost hydrogen could reduce the overall costs of producing crude oils and synthetic crude oils for refining, thus making Alberta products more competitive with imported oils. Recovery of hydrogen from sour gas would also enhance the economics of sour gas processing and possibly allow Alberta natural gas to be more competitive in domestic and foreign markets.

Southwest Alberta Renewable Energy Initiative

In recognition of Alberta's abundant and virtually untapped renewable energy resources, the Southwest Alberta Renewable Energy Initiative is supporting the development of wind energy, solar energy and other renewable energy technologies in the Pincher Creek area of Alberta.

The objectives of the Initiative are:

- in co-operation with industry, to develop environmentally acceptable renewable energy and energy conservation technologies suitable for Alberta's climate and
- to support the economic diversification of the Pincher Creek/Crowsnest Pass area by encouraging local businesses to participate in the program and develop expertise in renewable energy technologies.

Since the Initiative began in 1989, the construction of wind farms to demonstrate various technologies and the reliability of using the wind to generate electricity has begun, and solar energy and small hydro projects have begun operating.

It is anticipated that the technologies being demonstrated in this program will be applicable throughout southern Alberta and in many parts of the province.

Energy Efficiency Program

From 1977 to 1989, the Department of Energy supported research and development in the field of energy conservation and efficiency. In the three years that the program has been dormant it has become apparent that the services it provided in the past are still required. Thus, the program is being re-started with the principal objective of developing and demonstrating energy efficient technologies for use in the industrial, commercial and residential sectors. Also included in this program is a component on natural gas research that is focused on developing more efficient end-use technologies. This component is included in response to interest expressed by industry.

Combined with the accomplishments of the Southwest Alberta Renewable Energy Initiative, the energy efficiency program is expected to continue conserving non-renewable resources and help reduce the production of carbon dioxide emissions in Alberta.

Mineral Development Program

More than 20 industrial minerals are believed to be present in Alberta, but 95% of Alberta's mineral production comes from only four minerals — sulphur, limestone, sand and gravel. Together, these commodities

contribute approximately $600 million to Alberta's economy each year.

The objectives of a mineral development program funded jointly by the federal and Alberta governments are:

- to develop further Alberta's metallic and industrial minerals industries;
- to increase the productivity of these industries; and
- to improve the quantity and availability of mineral-related geoscience data.

The new mineral development program aims to produce detailed regional maps and commodity profiles, and will undertake geological exploration to identify new metallic and industrial mineral deposits. Also, the program will develop recovery, extraction and processing technologies for existing and new operations. Associated with this activity is the continuation of the current Alberta Geological Survey program in petroleum geology, basin analysis, coal geology and oil sands geology.

An improved understanding of the geologic environment, in combination with the development of mineral-related technologies, should open new opportunities for Alberta's energy and mineral industries and help make Alberta and Canada more self sufficient in these resources.

8.11 Alberta Environment

(a) Background

Alberta Environment's mission is to achieve the protection, improvement and wise use of our environment, now and in the future.

Alberta is committed to be a world leader in protecting our natural environment as the cornerstone of sustainable development, diversification and our quality of life. Alberta Environment was established in 1971, and through the powers vested in it through its enabling legislation, maintains active and effective programs in all key areas related to environmental monitoring and protection.

In 1990 the Government of Alberta presented its environmental vision to the public in a document entitled, "Alberta's Environment Toward the 21st Century." The document explained the government's commitment to achieve the department's mission through 10 environmental principles and 37 policy statements.

More than 25,000 vision documents were distributed throughout Alberta. Thousands of Albertans responded by letter to the Minister's invitation to "help shape our common future." Using this input, a first draft of the Alberta Environmental Protection and Enhancement Act was developed. This act will be the overall legislation which will protect our environment and provide the framework for the development and enforcement of environmental regulations for Alberta.

Alberta Environment is more than an environmental watch-dog. In establishing the Alberta Environmental Centre at Vegreville, it provided to Alberta one of the most comprehensive applied environmental research and analytical capabilities in the world. This technical capability enables the Alberta Government and private sector organizations to work together to make effective decisions regarding the development of the province's natural resources. Alberta Environment also has major applied research efforts in reclamation and in water resources management. Other elements of the

department which contribute to solving environmental problems include: the Alberta Environmental Research Trust, a research funding agency; the Alberta Special Waste Management Corporation, which oversees disposal of Alberta hazardous wastes and also supports research devoted to solving waste problems; the Environment Council of Alberta, primarily concerned with long-range strategic planning for addressing environmental issues; and the Natural Resources Conservation Board, which holds public hearings and issues decisions on proposals with sustainable development components. Alberta Environment has also established a number of mechanisms through which private citizens can participate in making rational decisions regarding our shared environment.

Other initiatives in meeting the challenge of the department's mission included involvement with the Canadian Council of Ministers of the Environment and in playing a key role in initiating the Alberta Round Table on Environment and Economy.

b) Department Objectives

1. Shared Responsibility

The Alberta Government will:

- 1.1 demonstrate leadership and co-ordinate action in order to assist Albertans in fulfilling this responsibility
- 1.2 assist the public and industry to recognize that the final responsibility for safe and prudent use of contaminants and potential contaminants rests with the individual and corporate user
- 1.3 share responsibility with the public and local authorities to reduce risks associated with natural events such as flooding and drought.

2. Leadership

The Alberta Government will:

- 2.1 use research and leading edge technology in the development of conservation, pollution prevention and reclamation standards
- 2.2 support and direct, through the internationally-recognized Alberta Environmental Centre at Vegreville, environmental research undertaken by industries, government agencies and universities to make the most effective use of resources and information
- 2.3 continue to encourage provincial utilization of Canada's only special waste treatment facility at Swan Hills.

3. Public Involvement

The Alberta Government will:

- 3.1 encourage and facilitate public participation through information sharing, education and consultation
- 3.2 make every effort to help Albertans understand that they are part of the environment and involves them in environmental protection and environmentally sustainable development
- 3.3 report regularly on the state of our environment as a primary means of sharing information.

4. Action on Environmental Protection

The Alberta Government will:

- 4.1 ensure a consistent high level of environmental quality for all Albertans
- 4.2 require the use of best available demonstrated technology to control contaminant emissions

4.3 monitor and evaluate ambient quality and emission sources to ensure environmental objectives are being met

4.4 promote and pursue waste reduction and recycling strategies to both protect our environment and conserve our resources

4.5 view reclamation as an integral part of industry's ongoing operations, and insist it be pre-planned

4.6 promote efficient operation and maintenance of facilities to reduce emissions and increase performance.

6. Polluters Pay

The Alberta Government will:

6.1 develop and maintain new comprehensive legislation to ensure that protection and enforcement actions meet current and evolving needs

6.2 ensure enforcement actions are timely and appropriate for both specified contravention and continued non-compliance

6.3 continue to apply enforcement firmly, fairly and consistently to all parties, including individuals, industries, municipalities, crown corporations and government agencies.

7. Integrated Decision-Making

The Alberta Government will:

7.1 manage water quality and quantity together, recognizing the interdependence of surface water, ground water and land

7.2 manage river basins on a multiple use basis

7.3 require consultation among all provincial departments and agencies to ensure environmental matters are given the fullest consideration.

8. Intergovernmental Co-operation

The Alberta Government will:

8.1 take a leadership role in achieving the co-ordination of policies and programs of all other levels of government as they relate to environmental matters in Alberta

8.2 work to ensure that Alberta's constitutional responsibilities for environmental management and protection are fulfilled

8.3 manage water for the benefit of Albertans and downstream users and will not party to any undertaking to divert water beyond Canadian borders

8.4 ensure that only Alberta-generated special wastes are disposed of in the province

8.5 be involved in co-ordinating national and international marketing of Alberta special waste management technology, research and training.

9. Sustainable Development

The Alberta Government will:

9.1 directly and in co-operation with others, manage water, land and air as sustaining elements of our environment for the benefit of future generations

9.2 require formal Environmental Impact Assessments (EIA's) for all major development. An EIA must predict the

sustainability of these developments and determines whether impacts can be mitigated. If these conditions are not met, the project will not proceed

9.3 maintain stream flows, protects basic water quality and instream uses to ensure that our rivers are sustained for future generations

9.4 require land to be reclaimed following development activity.

10. Improving our Environment for Future Generations

The Alberta Government will:

10.1 take improvement action where no responsible party can be found

10.2 encourage and undertake programs to enhance the environment and our quality of life

10.3 develop programs and standards to encourage local authorities to maintain effective infrastructure in order to protect high quality environmental health.

(c) Proposed Investment Levels in science and technology

The department's proposed S&T investment level for 1993/94 is $22.1 million to be allocated as follows in Table 8.11.1

A major concern in many of the plans for S&T investment relates to equipment recapitalisation of the department's S&T facilities. As an example, the Alberta Environmental Centre transferred several million dollars worth of equipment from Edmonton in 1979 and 1980, and purchased some $25 million worth of S&T-related equipment in the next few years. Since much of this equipment is now 10 or more years

Table 8.11.1

	Intramural		Extramural ($000)							
			Industry		Universities		Prov. Research		Others	
Programs	**R&D**	**RSA**	**R&D**	**RSA**	**R&D**	**RSA**	**R&D**	**RSA**	**R&D**	**RSA**
Air	1,562	1,677	10	80	–	–	550	–	–	25
Land	4,851	2,176	322	30	60	–	88	–	–	5
Water	2,344	3,436	520	453	210	–	620	–	–	1,083
Other Environmental Issues	–	1,072	–	175	99	5	50	–	–	5
Health	580	–	–	–	–	100	–	–	–	
Total	**9,829**	**7,869**	**1,027**	**662**	**270**	**5**	**1,408**	**–**	**–**	**1,118**
People	194.6	156	4	2.7	.6	–	7.8	–	–	5.2

old, it is worn out or obsolete. To replace old or obsolete equipment, the Alberta Environmental Centre urgently requires the implementation of a recapitalisation strategy; equipment replacement costs are currently estimated at $13 million. Failure to recapitalise means the ability to provide analytical and diagnostic support services, to work on environmental problems, and to develop modern environmental technologies are all becoming increasingly compromised.

(d) Organizations Involved

The Department of Environment and the Alberta Environmental Centre in Vegreville provide research services and expert advice for many departments in matters relating to environmental protection, assessment and standards. The Environment Council of Alberta, the Alberta Special Waste Management Corporation, and the Alberta Environmental Research Trust are funded mainly through the Department of Environment and are included in this discussion where appropriate. The Natural Resources Conservation Board is funded by the Department of Environment but does not get involved in any R&D or RSA, hence it is excluded.

A large number of the department's scientists and engineers serve on an array of planning and co-ordinating bodies and committees in program development and environmental assessment and protection.

Figure 8.11.2

	Program*							
Organizations Involved	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Alberta Environmental Centre	X	X	X	X	X	X		X
Alberta Environment	X	X	X	X	X	X	X	X
Alberta Health	X			X	X			
Alberta Forestry, Lands & Wildlife	X	X	X	X	X	X	X	
Alberta Research Council			X			X	X	
Alberta Recreation and Parks		X			X	X	X	
Alberta Agriculture	X	X	X	X	X	X	X	
Alberta Culture & Multiculturalism		X					X	
Alberta Technology, Research & Telecommunications				X	X			
Alberta Occupational Health & Safety						X		
Alberta Energy		X						
Alberta Public Works, Supply and Services				X	X		X	
Alberta Special Waste Management Corporation		X						X
Alberta Environmental Research Trust	X	X				X		
Agriculture Canada	X					X	X	
Environment Council of Alberta								X
Industry	X				X	X	X	

*Programs: 1. Water & Wastewater Management; 2. Air & Waste Management Research; 3. Trace Analysis; 4. Pest Management; 5. Environmental Toxicology; 6. Environmental Enhancement; 7. Water Resources; 8. Strategic Planning.

The programs are generally funded by the Department for the clients illustrated in table 8.11.2. In addition, projects are carried out for private industry on a contract basis.

(e) Key Program Elements

1. Water & Wastewater Management

1.1 Mission: Characterizing and solving water pollution problems

1.2 Wastewater Management

Activities

- A comprehensive study to completely characterize the immediate, short term and long term impact of biochemical oxygen demand constituents from pulp mill effluents on the surface water quality of receiving streams.

Expected impact

- Providing data on the long term decay of biodegradable organic constituents has assisted river modelling consultants who are evaluating the short term and the long term impact of pulp mill effluents on the dissolved oxygen content of receiving waters downstream of existing and newly proposed pulp mills in Alberta. Existing and proposed new mills will be affected significantly.

1.3 Analytical, Diagnostic and Technical Services

Activities

- New methods developed for the quantitation of hydrogen sulphide in environmental samples (water and wastewater), biological tissues and biological fluids.
- Completed method development for the analysis of heavy metals in biota and river and lake sediments.
- Completed method development for the analysis of organic mercury content in fish muscle tissue.

Expected impact

- The new analytical methods for sulphide have permitted the assay of human brain tissue for elevated H_2S levels associated with suspected H_2S poisonings. This analytical procedure has provided medical examiners with the only reliable diagnostic tool to confirm fatal H_2S poisonings.
- Extending Alberta Environment's analytical capability to include heavy metals quantitation in plant and animal tissues as well as biological fluids permits new research to be conducted on environmental pathways for contaminant movement in the ecosystem; of importance to regulators and licensors.
- Complete quantitation of the total and organic fraction of mercury in fish tissue is available to ecosystem researchers and fish monitoring agencies within the Government of Alberta. Health concerns can then be addressed.

1.4 Water Resources Programs

Activities

- A disinfection procedure to remove infectious pancreatic necrosis (IPN) virus from Cold Lake Fish Hatchery intake water has been successfully developed.

Expected impact

- The new Forestry, Lands and Wildlife fish hatchery at Cold Lake will become operational without fish egg and fish fry exposure to the naturally occurring Cold Lake IPN virus. Rearing fish in disinfected waters for transplanting to other lakes in Alberta will reduce the spread of isolated fish diseases.

2. Air & Waste Management Research

2.1 Mission: Characterizing & Solving air pollution and waste management problems.

2.2 Air Analytical Services

Activities

- Ambient air and source emission samples collected province-wide by Alberta Environment continue to be analyzed at the Alberta Environmental Centre. The sampling network includes fixed monitoring stations in urban and industrial areas. Air samples were also collected and analyzed for complaint and investigation purposes.

Expected impact

- By providing a state-of-the-art analytical service the Centre plays a key role as backup to the regulatory services which ensure that the province's air quality continues to meet high standards and that all industries in the province comply with their licence requirements.

2.3 Acid Deposition

Activities

- An Acid Deposition Management Strategy for Alberta was proposed by a Task Group November 1, 1988 and approved by the Deputy Minister March 21, 1989. The Acid Deposition Program was added to the Alberta Environmental Centre's responsibilities in 1990-91 to ensure a co-ordinated approach to implementation of the management strategy recommendations for both the Acid Deposition Research and the Western and Northern Canada Long Range Transport of Air Pollutants (LRTAP) programs.

Expected impact

- Program goals are to provide scientific and technical knowledge for limiting acid deposition, monitor wet and dry deposition of acidic substances, and establish reliable methods for prediction of acid deposition and its effects (such as acid rain) in Alberta.

2.4 Incineration

Activities

- Solid and liquid feeds, spiked with chlorinated organic compounds, were used in the Centre's pilot facility to ensure proper operation and to verify sampling and analytical methods. Progress was made in sampling and analytical methods development for the measurement of trace organics in flue gases, including investigation of the effect of hydrochloric acid. Dioxin and furan analytical procedures were added to the laboratory's capabilities.

- The quality assurance method used at the Alberta Special Waste Treatment Centre was further developed at the Alberta Environmental Centre so that it can now be used as a regulatory tool for proving that licence requirements are complied with.

Expected impact

- The main goal is to develop sound waste management practices by evaluating different strategies including incineration, solidification, composting and others and ensuring that emissions from these are minimized and understood.

2.5 Microbiology

Activities

- The Centre's microbiological analytical services continuing to be used by many external and internal clients are identifications, toxicity testing and quantification of microbial populations in waters, soils and wastewaters.
- Research on microbiological processes in waste management involved experimental work on chromium removal from industrial wastes using bioreactors, performance assessment of on-site domestic wastewater treatment technology, and the detection and quantification of odorous compounds of microbial origin associated with piggery waste.

Expected impact

- Continued support to Alberta Environment and Agriculture in the identification, enumeration, and toxicity assessment areas.
- Develop, evaluate and transfer the technology of promising processes, e.g. biofilter, resource recovery from gypsum, pig waste odour control and white-rot fungi applications.

3. Trace Analysis

3.1 Mission: Characterizing and measuring of environmental samples.

3.2 Environmental Isotopes

Activities

- Continuing work on environmental, general earth sciences or other problems requiring geochemical isotopic techniques.

Expected Impact(s)

- Problems under investigation or solved include:

  origins and solutions to soil salinity problems, aquifer characterization, wastewater contamination vectors, sulphur sources in acid deposition, erosion rates, basin source water, assistance in preservation of our national heritage by analysis of archaeological specimens at the Old Man River Dam Reservoir, and the International Heritage Site at Head-Smashed-In-Buffalo Jump.

3.3 Organics — Regulatory

Activities

- Continued support to client groups (primarily Alberta Environment) in their regulatory, monitoring and environmental emergency roles.
- Continue to provide consultation and advice on analysis of organics, and related technical issues.

Expected impact

- Contribution to continued good health of Albertans through regular and systematic analysis of drinking water throughout the entire province.
- Ensuring that enforcement of new environmental legislation is possible, through continued development and enhancement of analytical tests.
- Understanding of fate and effect processes of chemicals associated with pulp mills discharging effluents in northern Alberta River systems.

4. Pest Management

4.1 Mission: Characterizing and solving the problems of pests and pest management.

4.2 Pest Management Program

Activities

- On-going and timely diagnostic and advisory services are provided in insect pests, plant diseases, weeds, and chemical damage to crops and other vegetation to agricultural producers and the public at large. The pesticide chemical damage service provided by AEC is the only one in western Canada.
- Research in the area of weed ecology has led to the development of a computer program based on the mathematical models developed for estimating crop yield losses due to weeds.
- Research on the biological control of weeds with insects that are natural enemies (parasites or predators) of the target weed in environmentally sensitive areas has produced some spectacular results. For example, a root-feeding beetle is well established on hundreds of sits in Alberta to control leafy spurge.

Expected Benefits

- The pest diagnostic service contributed to saving millions of dollars from pest damage to crops.(For example, surveys, monitoring and prevention for diseases like blackleg of canola will save the canola producers millions of dollars in crop losses from this devastating disease. As a result of the diagnosis provided to Alberta farmers, most claims for damages are now settled out-of-court. The use of the computer program for crop loss estimation has helped farmers reduce herbicide use in the prairie provinces by 15% or more. In Alberta this translates to reduced input costs of approximately $20 million annually.)
- Development of cost effective methods for rehabilitation of soil sterilant affected sites and oil and gas well leases will immediately benefit the energy industry and the farming community.
- Use of biocontrol techniques is both economical and environmentally safe compared to chemical control.
- Research on ecological approaches to weed management will continue with emphasis on cultural practices such as reducing the impact of weeds on crops by increasing crop seeding rates and decreasing row spacing.

5. Environmental Toxicology

5.1 Mission: Characterizing the effectiveness and assessing the risks of environmental changes on animals including man.

5.2 Toxicology of petrochemicals

Activities

- Conducted several in-depth veterinary toxicology field investigations into possible environmental contamination of livestock.
- At the specific request of the Energy Resources Conservation Board, provided expert advice in veterinary toxicology on possible adverse health effects in livestock associated with the petroleum industry.
- At the request of Pollution Control Division, provided expert testimony in environmental toxicology at the Okotoks Public Hearing on a landfill dispute.
- Conducted research on diagnostic biomarkers of crude oil exposure and oil-field chemical exposure in cattle.
- Developed a novel tissue based procedure for quantitative assessment of chemical injury to the eye, as a model for human and livestock exposures.
- Investigated the uptake of hydrogen sulphide by the respiratory tract.
- At the request of Wastes and Chemical Division, provided expert information on toxicology matters related to Alberta Special Waste Management Corporation, Celanese Canada Inc., and Clover Bar Sands and Gravel Ltd.
- At the request of Alberta Occupational Health and Safety, Energy Resources Conservation Board, Washington Department of Health, Natural Sciences and Engineering Research Council of Canada, provided expert advice and information on toxicology.
- Established baseline blood and body chemistry values for free-ranging Woodland Caribou in northern Alberta.
- Developed diagnostic tests for determining ingestion of diethylene glycol in cattle.

Expected impact

- Ensure bodies involved in licensing, monitoring, enforcement and prosecution have the appropriate expert advice for setting new regulations and standards (e.g. for pulp mills, new industries, waste management and disposal practices); provide expert witnesses for both government and civil court cases, public hearings and government panels; assist in the evaluation of Environmental Impact Assessments (EIA's).
- Decrease in health risk due to various health issues: including development of a technique for removing a widely present intestinal parasite from drinking water; work on hydrogen sulphide leading to new treatment methods for hydrogen sulphide poisoning; determination of levels of mercury and pesticides in essentially all fish populations in Alberta, leading to new fish consumption guidelines.

6. Environmental Enhancement

6.1 Mission: Characterizing ecosystems and developing ways of restoring habitats

6.2 Soil, Vegetation and Wildlife and Aquatic Ecology

Activities

- Provided diagnostic and advisory services in aquatic biology/toxicology, wildlife biology and soil reclamation to our clients (mainly government agencies).
- Technology transfer: provided aquatic bioassay methods to three private labs.
- Designed and put into field operation a Bio-Reactor capable of testing the optimal conditions for rapid degradation of petroleum contaminants in soil.
- Developed a method of aggregating oil-contaminated soil to optimize biodegradation of hydrocarbons and leaching of salts.
- Developed in co-operation with the National Research Council a solvent extraction process for removing petroleum contaminants from soils and coupled it with the soil aggregation process to yield clean and friable soil suitable for cultivating.
- Tested the reclamation potential of a "winged subsoiler" to break up compacted soils on forest haul roads and landings.
- Developed several new methods and pieces of equipment for integrating soil science and engineering testing to quantify the process of soil deformation by heavy machines.

Expected impact

- Dependable monitoring of the impact of industrial activities (such as river dams, pulp mills) on aquatic habitats.
- Economic and environmentally safe methods will be available for managing aquatic & weeds in irrigation canals and farm dugouts, and pocket gophers in forage crops, presently costing $15-40 million in Alberta.
- Establishing that fish in the Oldman River Dam Reservoir is safe for human consumption.
- Selected lines of native grasses will be available commercially for land reclamation, soil conservation and renewing wildlife habitat.
- Biodiversity data will be one of the important contributions to economically acceptable management of natural resources, i.e. forest, wildlife.
- Ability to reduce the impact of forest harvesting activities on soil and to reclaim the degraded soil will support the multi- billion dollar industry in Alberta.
- Economic, efficient and environmentally safe technology i.e. Bio-Reactor and SESA,

7. Water Resources

7.1 Mission: To provide overall management of water resources within Alberta and for water resource matters held in common with other provinces and the federal government.

7.2 Physical and Quantitative Assessment of the Occurrence, Movement, Control and Effect of Water

Activities

- Provide all the land and water surveys required by Alberta Environment.
- Determine the annual and seasonal volume of streamflow including extreme events like flooding, river erosion, etc.
- Identify, protect and enhance and conserve Alberta's groundwater resources.

Expected impact

- River streamflow is monitored and flood forecasting is provided to minimize damage and prevent disasters.
- Information collected is used for river basin planning, reservoir design and lake stabilization.

7.3 Investigation, design, operation and maintenance of water management projects

Activities

- Operate and maintain the 240 provincially-owned and cost-shared multi-purpose water management projects which provide flood, erosion and drainage control, water conservation, stream flow regulation, lake stabilization, recreation, wildlife and waterfowl habitat and assured water supplies for many towns and villages.

Expected impact

- Forecasts forewarn communities of potential flood or drought thereby providing time for preventative or remedial action.
- Water basin planning recommends ways of meeting future needs, resolves allocation and environmental problems, and provides guidance for the development of water resource projects.

8. Strategic Planning

8.1 Mission: To ensure that the principles of sustainable development are an integral component of the department's management,related scientific activities, and its R&D.

8.2 Corporate and Strategic Management

Activities

- Assess the state of existing legislation and regulations, and draft new ones based on the best available science.
- Determine areas of strategic environmental importance to Alberta in future years, and ensure that R&D is positioned to meet these priorities.
- Co-ordinate the department's activities with the federal and other provincial governments

Expected impact

- The department will be better able to anticipate and respond to environmental and social issues and requirements.
- Co-ordination of the environmental activities of other Alberta Government departments.

8.12 Alberta Forestry, Lands and Wildlife

(a) Background

The total land area of Alberta is 661,185 square kilometres of which about 62% is under provincial control as public land under the management of Forestry, Lands and Wildlife. Some 350,000 square kilometres (60% of the province) are Crown-held forests that provide habitat for wildlife, retreat and recreation for campers, hikers, skiers, hunters and fishermen. These lands provide a source for timber harvesting, oil and gas exploration, mining and animal grazing. Alberta's productive and potentially productive forest lands cover some 200,000 square kilometres. Integrated resource management involving public planning and management is used to co-operatively develop the resources. The value of products produced from this resource is estimated to be $1.6 billion in 1992 and is expected to increase to $2 billion by 1994. Continued management and sustainable resource development will rely heavily on technology development and application.

(b) Department Objectives

Alberta Forest Service

- To provide improved forest management planning, reforestation techniques, genetics and tree improvement, fire, insect disease control.

Forest Industry Development

- To assist Alberta based companies in developing and using leading edge forest product technology and to enhance the utilization of provincial forest resources.

Fish and Wildlife

- To investigate and identify the distribution and population of threatened game species. To conduct/support research into fish and wildlife parasites and diseases.

Public Lands

- No R&D or related scientific activities are conducted.

Land Information Services

- To provide survey and mapping systems for the province for use by Government departments or the private sector. To update and distribute surveying and mapping information through a central registry.

The department is being advised by the Alberta Forest Research Advisory Council (AFRAC) on strategic directions and priorities concerning forestry and forest product research and development.

(c) Proposed Investment Level

Forestry, Lands and Wildlife proposes to invest $2.79 million in research programs in 1993/94 and $23.47 million in related scientific activities for a total of $26.26 million (Table 8.12.1).

The investment is leveraged at a ratio of 2:1 through co-operative programs with industry, industry associations, federal and Provincial departments, research agencies and universities.

The Estimated Capital Budget for 1993/94 in R&D and RSA is shown in Table 8.12.2.

Table 8.12.2

Division	($000) 1993/94
Alberta Forest Service	$37.4
Forest Industry Division	0
Public Lands	0
Fish and Wildlife	50.0
Land Information Services	839.0
Total	$926.4

Program Changes

Some highlights of the changes in programs since the 1991/92 budget cuts are:

Alberta Forest Service

Expiry of the Forestry Canada/Forestry, Lands and Wildlife agreement in fire research will result in a loss of approximately $200,000 per year. New fire research funds may be available under the recently signed Canada/Alberta Partnership Agreement in Forestry.

Forest Industry Division

No program changes, but the overall budget has been reduced.

Public Lands

None

Fish and Wildlife

None

Land Information Services

The RSA budget of the division is expected to be reduced by $1,000,000 in 1993/94.

(d) Organizations Involved

Forestry, Lands and Wildlife under the Chair of the Deputy Minister has established a Forestry Research Advisory Committee, composed of senior representatives from provincial, federal and industrial organizations to define the critical research priorities in the forestry industry and to oversee the resulting R&D programs. This committee is working closely with a network of research agencies, with a few examples identified below:

- The principal mandate of the forest products program of the Alberta Research Council is to maintain a world class panelboard research, development and testing facility, to develop new panelboard products, and to serve as an accredited testing agency for international standards to assist Alberta producers obtain access to foreign markets.

Table 8.12.1

Division	($000) R&D	($000) RSA	Departmental People Man Years
Alberta Forest Service	868.0	961.5	23
Forest Industry Development	1,808.0	0	3
Public Lands	0	0	0
Fish and Wildlife	116.5	1,143.6	23
Land Information Services	0	21,316.0	221
Totals	2,792.5	23,465.1	270
Total R&D and RSA		**26,257.6**	

- The Forest Engineering Research Institute of Canada (FERIC) is a government and industry funded, non profit research agency whose mandate is to develop and assess mechanical harvesting, loading, hauling, scarification and planting equipment and systems in co-operation with the primary forest industry. FERIC and ARC have developed a memorandum of understanding to avoid duplication and ensure full co-operation of the two organizations.
- Forintek Canada Corporation is a government and industry funded non-profit research agency whose mandate is to be Canada's leading research organization in the area of solid forest products, engineered composite products, adhesives and wood protection.
- Recently Forintek, ARC and the Structural Board Association have developed a tripartite alliance to ensure co-ordinated research programs addressing the R&D priorities of the North American Structural Panel Industry.
- The Pulp and Paper Research Institute of Canada(PPRICAN) is a government and industry funded non-profit research organization whose mandate is to provide research and technical assistance to the Canadian pulp and paper industry. However, its activities are focused on chemical pulp mills.
- The chemithermomechanical pulp (CTMP) Industry and ARC are co-operating in a research program to address CTMP R&D priorities.
- Forestry and forest products R&D branches of Forestry, Lands and Wildlife regularly contract professors from the Department of Forest Science, Agricultural Engineering and Rural Economy at the University of Alberta to undertake research studies in their respective fields. On occasion, expertise from the universities of Toronto, Trois Rivieres, Sherbrooke, New Brunswick and British Columbia are invited to participate in appropriate projects.
- The Fish and Wildlife research divisions of Forestry, Lands and Wildlife regularly consult with the Microbiology Department of the University of Alberta.

Funds identified to support R&D and RSA in other departments, agencies, universities or industry are shown in Table 8.12.3

Table 8.12.3

Division	($000) 1993/94
Alberta Forest Service	187.3
Forest Industry Development	700.0
Public Lands	0
Fish and Wildlife	16.5
Land Information Services	0
Total	903.8

(e) Key Program Elements

- The ARC program will undertake forest product research appropriate to Alberta resources and industry, using a development and testing facility accredited to international standards.

- New and improved oriented strandboards will be developed with improved dimensional stability in order to penetrate previously restricted overseas markets
- Characterization of Alberta wood species such as whitebark pine to exploit its optimum utilization potential
- Assist the sawmill industry to develop the machine stress-rated lumber market for offshore markets
- Assist in the development of new cost-effective wood and/or wood based building components based on laminated beams, laminated veneer lumber and oriented strand lumber technologies
- Under the Alliance Program ARC and Forintek will be conducting joint research projects addressing the North American Structural Board Industry, with priorities such as the development of improved pressing technology, high moisture tolerant adhesion, etc.
- A value-added products program will develop cost- effective products from low value wood fibre including the use of wood residues in pulping, and power generation.
- A pulp and paper program will undertake pulping and paper making trials in support of proposed fine paper mills and mill expansions. Alternate fibre supplies for roofing mills as well as technological improvements for efficiency and new products will be identified.
- The CTMP initiative will acquire both equipment and expertise to undertake research in process and product improvement. This will allow Alberta CTMP mills to be leaders in this new and expanding industry. Improvements required are in the area of increased brightness with lower chemical consumption, reduced fines, higher yields, lower water consumption and less effluent.
- Under the leadership of PPRICAN and Alberta Environmental Centre, a research program has been established in order to develop more efficient effluent treatment processes and equipment with the ultimate goal of achieving a zero discharge rate for kraft mills.
- Forintek's Alberta program assists small to medium sized sawmills to achieve better yields and grades of lumber with a minimum amount of capital investment. Kiln drying schedules specifically geared to dry Alberta Spruce Pine Fir (SPF) are being developed for value added products and to deal with the pine nematode issue.
- FERIC's Alberta program will test and demonstrate new mobile chipping and harvesting systems suitable for Alberta species and conditions. A central tire inflation system to reduce maintenance of logging roads and to improve vehicle performance will be tested.
- The University of Alberta program will develop multiple use forest models with values for non consumptive uses. Other priorities will be to determine the economic impact of forestry in Alberta, and to determine the extent of private woodlots in Alberta and to develop an appropriate management program.
- Co-operative programs with the University of Alberta are aimed at sustaining fish production in the Province

to meet recreational, commercial and domestic fishing needs. These programs study diseases, factors affecting natural spawning and hatchery rearing methods. Other university programs will examine approaches and procedures to assess and manage wildlife and the study of parasites and diseases of wildlife in support of the development of the game farm industry and the conservation and protection of our wildlife population.

- A humane trap development and research program at ARC will lead to the establishment of international standards for the manufacturing of humane trapping devices.
- A number of industry/government funded R&D projects will investigate and evaluate new wood products, special coatings, resins, markets, quality control systems, processing equipment, recycling, new standards, etc.

(f) Expected impact

- The proposed research programs are expected to generate significant benefits to Alberta over the next three years and what follows are some highlights:
- The establishment of a greenfield fine paper mill based on the CTMP process, involving an investment of about $650 million and creation of 150 jobs
- An increase in offshore exports of wood products of between 10-20% and increased revenues of $5-7 million as export grades will command premium prices
- An industry wide savings of $5/tonne for residue disposal amounting to about $10 million
- An efficiency improvement in lumber production of 5% for small and medium sized mills at an increased value of $3 million
- Increased sales of high tech equipment of about $1 million
- An improvement in logging and hauling efficiencies of 10% involving an industry wide saving of $10 million
- An increase in panelboard process efficiency of between 5-10% due to improved waferizer performance, use of balsam poplar and higher moisture tolerant resins. Savings estimated at about $5 million
- A reduction in water consumption by CTMP mills of at least 25% and savings of $250,000 per mill in reduced effluent treatment cost

8.13 Alberta Health

(a) Background

Alberta Health's mission is to promote, maintain and improve the health of Albertans by providing direction in the management of resources and ensuring appropriate, accessible and affordable health services in the province.

The health services are provided through the 27 public health units, almost 300 hospitals and long term care facilities which are operated by autonomous boards, and 56 mental health clinics, in addition to thousands of private practice health professionals. These health services are provided by a broad spectrum of health professionals including physicians, nurses, physiotherapists, optometrists, and other health professionals.

Health research, with particular focus on health services research and innovation, will contribute to improving the effectiveness of health services in the province and ultimately contribute to the improved health of Albertans.

In order to enhance the setting of research priorities, advice on the priorities of health research and technology assessment should come from multiple sources, including provincial and national experts. This view has led to the creation of the Provincial Advisory Committee on Health Research (PACHR) which commenced operations in August 1992. This committee reflects expertise in epidemiology, nursing, medicine, economics, social sciences, public health, administration, and research in order to address the multi-disciplinary and complex nature of health research. PACHR will report to and advise the Minister of Health on matters relating to health services research and technology assessment, and select research projects for funding under the auspices of the Health Services Research and Innovation Fund.

With this Fund, it is Alberta Health's intention to foster innovation in the development, organization and delivery of health services to increase quality and promote cost efficiency and effectiveness. Alberta Health also intends to explore the potential for cost stabilization or savings to the health system in the short and long term. Additionally, Alberta Health intends to ensure formulation of priorities for health research, in particular health services research and innovation,and technology assessment, useful to policy formulation and program development, and to periodically review these priorities.

Representation on the Technology and Research Advisory Committee (TRAC) and chairing the TRAC Subcommittee on Health Research, has also allowed Alberta Health to become more involved in the co-ordination of government sponsored health research. Additionally, the department is establishing a special health technology assessment implementation committee with liaison to health sectors, industry and the Alberta Research Council.

(b) Department Objectives

The overall mission of Alberta Health is to promote, maintain, and improve the health of Albertans, by providing direction in the management of resources and ensuring appropriate, accessible and affordable health services in the province. The mission statement has a dual focus: population/people health and management of the system.

The vision for the health system in Alberta incorporates the following:

- The future of the health system in Alberta will be one in which the commonly held principles of health care which Albertans cherish will be strengthened and enhanced
- Alberta Health's system will strive to keep Albertans healthy and independent in their own homes and communities for as long as possible, yet have reasonable access to leading edge technology, medical procedures, professional expertise and drugs whenever treatment is required
- The health system will be better managed and adequately funded

- All health professionals and organizations will work together in a spirit of co-operation and collaboration. Hospitals, health units, long-term care facilities, mental health clinics, health service providers, and volunteer organizations will provide a continuum of high quality health services.

The strategic directions deemed necessary to achieve Alberta Health's mission and vision are as follows:

1. Effectiveness
   - Provision of a health system which is appropriate hinges on accountability at all levels. Health programs and services delivered or funded by Alberta Health should be effective. They must contribute to the improved health of Albertans.
2. Access to Health Services Continuum
   - Health services must be accessible and offer appropriate choices along the spectrum of services.
3. Health Promotion and Disease/Injury Prevention
   - Awareness and understanding of how to remain healthy and improve our health are essential.
4. Fiscal Resource Management
   - The future of Alberta's health system depends on the management of fiscal resources.
5. Human Resource Management
   - Health human resources significantly influence the quality and accessibility of health services, as well as expenditure of available funds. Collaboration with employer organizations, unions, professional associations, educators and other Government departments is essential to provide cost-effective, quality services.
6. Health System Organization
   - While adhering to the legislative framework and overall direction and standards provided by the government, the health system must have the capacity to accommodate the changing health needs of Albertans and their communities.

The health research objectives are as follows:

- to ensure the formulation of priorities for health research, in particular health services research and innovation and technology assessment useful to policy formulation and program development, and to periodically review these priorities
- to ensure that all necessary protocols, procedures and criteria, including ethical reviews, are developed and applied when evaluating health services research and innovation proposals
- to ensure that criteria for the assessment of health technologies are developed in consultation with appropriate national bodies and other external representatives
- to ensure the province has an inventory of health services research and technology assessment projects and findings, and that this information is appropriately disseminated and,

where appropriate, incorporated into policy and practice

- to ensure that the results, appropriateness, relevance, acceptance, responsiveness, secondary impacts, and costs which contribute to effectively managing the health system are measured and that the outcomes are appropriately applied

(c) Proposed Investment Level

(d) Organizations Involved

Alberta Health works in partnership with health practioners, professional associations, health units, hospitals, agencies, universities, and other interested groups to ensure a co-ordinated approach to the delivery of health services. To ensure a co-ordinated approach to the conduct of health services research, the involvement of universities, hospitals, and health units is vital. They have necessary and complementary resources crucial to the success of this initiative. While Alberta Health may focus on the development of a health services research agenda and provide some financial support, as well as access in accordance with confidentiality provisions to data bases, the other stake holders provide technical, clinical and research expertise, and field settings for the conduct of this research. Linkages have also been established by Alberta Health at both the federal and interprovincial level.

Table 8.13.1 1993/94 Proposed Investment Level ($ Million)

	R&D	RSA	Total
Extramural			
Alberta Mental Health Research Fund	0.67	–	0.67
Health Services Research & Innovation Fund	–	1.0	1.0
Applied Research Cancer Program	2.8	–	2.8
Other Studies	0.02	0.54	0.56
Intramural			
Administration of Studies and Related Activities	0.24	0.47	0.71
Administration of Extramural Programs	0.03	0.13	0.16
Capital	–	0.01	0.01
Total	3.76	2.15	5.91

*These are budget estimates based on the 1992/93 budget.

The department works with committees and boards to establish and implement policies and guidelines on receiving and processing grants for research proposals. The committees and boards consist of experts in the field who also evaluate proposals and develop the research policies. The committees described below will co-ordinate health research at the government, inter-department, and health research community levels:

- Alberta Health has representation on the Technology and Research Advisory Committee (TRAC). This Committee, reporting to the Minister of Technology, Research and Telecommunications (TRT), is an inter-departmental and government agency committee charged with the overall co-ordination of research across government.
- Alberta Health chairs the TRAC Sub-committee on Health Research. The sub-committee facilitates the co-ordination of Government sponsored health research.
- The Provincial Advisory Committee on Health Research (PACHR) will report to, and advise, the Minister of Health on matters relating to health research, health services research, the Health Services Research and Innovation Fund, and technology assessment. Membership of this Committee was drawn from experts primarily in the health research community. Public views are also represented on this committee.
- To ensure that internal issues related to health research and technology assessment are properly addressed and co-ordinated, a Health Research and Technology Issues Committee has been created within Alberta Health.
- Links to the National Health Research and Development Program (NHRDP) have been established to help set the national research priorities and recommend Alberta based projects.
- Links to the other western provincial departments of health have been established to identify common research interests and explore ways to collaborate in the conduct of health services research.

(e) Key Program Elements

Applied Cancer Research Program

- Programs for the prevention, detection and diagnosis of cancer will be continued, including programs on the treatment and care for cancer patients.
- A diverse range of significant projects have been undertaken to remain on the leading edge of cancer treatment and research, including the use of genetic markers for screening programs, and the utilization of monoclonal antibodies and radiopharmaceuticals for treatment.
- In addition to the $2.8 million provided by the Alberta Heritage Savings Trust Fund for applied cancer research, the Alberta Cancer Board generates significant revenue from outside the province for research activities, including an additional $2.8 million from other sources such as the National Cancer Institute of Canada, The Canadian Cancer Society, and various companies from the pharmaceutical industry, to name a few.

Mental Health Research Fund

- The Mental Health Research Fund supports mental health researchers in the province with the objective of promoting mental health research and training.

- The fund has recently supported the establishment of a research unit at The University of Calgary to investigate developmentally disabled children and explore causes of learning and attention disorders, including genetic studies of children with dyslexia.
- Previous grants have supported studies examining the biochemical causes of depression and schizophrenia, as well as different treatment modalities for various mental illnesses.
- Researchers funded by the Mental Health Research Fund also obtain support from a variety of national research bodies and industry.

Health Services Research and Innovation Fund

- Alberta Health will support innovation in the development, organization and delivery of health services to increase quality and promote cost efficiency and effectiveness. New approaches to disease/injury prevention and health promotion will be supported to enhance quality of life and the potential for cost stabilization or savings. Focus will also be placed on the formulation of priorities for health research, in particular health services research and innovation, and technology assessment, useful to policy formulation and program development, and to periodically review these priorities.

(f) Expected impact

The development of a) systems (organization structures, resources, techniques) required to assess the outcomes of health care in terms of effectiveness and efficiency, and b) knowledge about the impact of various reimbursement, organization and delivery systems on access and quality of care in health services, will ensure the continuing development of sound management practices.

In addition, the application of new knowledge, practices and medication combined with education on health promotion, will improve the quality of care to individual Albertans and improve family and community well-being and reduce the pressures on escalating health costs.

The organizational arrangement of the health research system enables the Minister of Health to have direct input into the health research agenda and to draw upon health services research findings and expertise in policy formulation and program planning. Health services research, principally dealing with issues of effective and appropriate health program delivery will be placed within the overall context of all health research, including biomedical research.

8.14 Alberta Occupational Health and Safety (AOHS)

(a) Background

Alberta has one of the best workplace health and safety records in Canada. Alberta's lost-time claim rate is one of the lowest in the country. Over the past decade the injury rate has declined substantially. In 1981 one out of every 15 workers was injured on the job (a rate of 6.7 per 100 workers), while in 1991, one out of every 23 workers was injured (a rate of 4.4 per 100 workers).

In spite of the intensive efforts by industry and Government, each year more than 37,000 Albertans sustain workplace injuries, and about 85 work-related fatalities occur.

Occupational Health and Safety programs are designed to protect more than 900,000 workers in Alberta. During the past several decades there have been significant changes in the workplace, coincident with the diversification from an agricultural-based work force. Industries are expanding, and processes are being mechanized, such as in forestry. The hazards and control procedures change as new work procedures are introduced. While the injury risk remains high in this industry, forestry's lost time claims rate has declined 26% since 1987.

The number of job changes in a career span is increasing, exposing more workers to unfamiliar conditions. New workers (those with less than six months on the job) have a higher risk of injury than other workers.

Manufacturing processes are more complex, with higher speed machinery operating at elevated temperatures and pressure. Workers are exposed to a wider variety of chemicals. New chemicals are introduced and their long term health effects may not be known. Recycling and the disposal of hazardous wastes add to safety concerns in the workplace.

The public is showing much less tolerance towards unsafe workplaces and work practices. Some organizations have achieved sustained periods of no lost time claims, but these are exceptions, and the injury-free workplace is far from being assured.

(b) The Department's Objectives

Research conducted or funded by AOHS is designed to improve the health and safety of Alberta's workers and to achieve healthier and safer work environments. Leadership is required by Government in setting standards and ensuring advanced safety practices are developed and applied.

Internal research is directed toward supporting departmental planning, policy and program development, and providing research information and advice to employers, workers and researchers.

The Occupational Health and Safety Heritage Grant Program supports educational, research and conference activities aimed at preventing occupational injuries and illnesses and which promote the health and well being of Alberta workers. The Heritage Grant Program provides funding to employer and worker organizations and to post secondary institutions. The major emphasis is placed on funding applied research that is directed towards solving high priority occupational health and safety problems.

(c) Proposed Investment Level

Table 8.14.1 1993/94 Proposed Investment Level ($000)

Projected Investments	Related Scientific Activity	Research and Development	Totals
Universities	0	250	250
Industry	0	75	75
Other	0	65	65
Internal	374	261	635
Totals	374	651	1,025

AOHS has proposed to invest $1.025 million in R&D and RSA in 1993/94. This is equivalent to .002% of Alberta's total GNP and it represents 0.2% of the cost of WCB claims made on behalf of industry for workplace injuries and illnesses.

The program began in 1981. The Heritage Grant Program is guided by a steering committee with representatives from several government departments as well as industry, labour, and the public.

The program receives approval to continue on a year-to-year basis. The uncertain future of the Heritage Grant Program is a deterrent to the development of important long term research projects. As no other funding source has a similar mandate, a long term funding commitment is needed to ensure that research is undertaken in Alberta which helps to solve health and safety problems.

(d) Organizations Involved

Educational institutions have received 55% of the funds of the Heritage Grant Program since the program started. Employer/industry associations and individual companies made up the majority of the remaining recipients.

Of the 66 research projects funded by the program, 27 received additional funding from other sources. The co-funding from industry and other organizations has taken many different forms, from cash funding to donating time and expertise. In the last three years, for every grant dollar awarded, industry, the federal government, and other government departments contributed 56 cents towards grant projects. Proposals indicating a commitment of co-funding from industry are preferred by the Heritage Grant Program.

(e) Key Program Elements

Internal Research

Examples of research conducted by the department are described below.

- The contribution of workplace and workforce characteristics to the incidence of injuries and ill health are studied. For example, the findings from a literature review of the effect of age upon occupational health and safety is used to develop prevention programs which reflect a specific industry's workforce.
- Statistical studies estimate the risk of injury for specific occupational groups and examine the type of injuries likely to occur, and the cause of these injuries. For example, loggers are most likely to be injured by falling trees or struck by chain saws. This kind on analysis focuses the department's efforts in working with industry to reduce injuries.
- Epidemiological research, such as studying noise exposure of Alberta workers, to determine the cause of and prevent future occupational illness.
- Program evaluations to focus and improve the department's programs and services. For example, library services and health and safety programs have been evaluated.
- Hygiene field studies, to collect information on occupational exposures and determine whether revisions to occupational exposure limits, included in Regulations, are needed.
- Development of new laboratory methods related to occupational hygiene to better detect potentially harmful substances which affect the health of workers.
- Technical surveys of ergonomics risks at Alberta work sites.

External Research

- Current funding priorities of the Heritage Grant Program include:
  - fatal and serious injury accidents
  - small business

- chemical and biological hazards
- hazards in the oil and gas industry
- hazards in the forest industry
- initiatives for young/new workers
- initiatives related to literacy/English as a second language

- Research projects recently approved or completed include:
  - *An investigation of the impact of alcohol and drug use on the Alberta workplace.* Enquiries to AOHS on substance use, drug screening and employee assistance programs are increasing. Knowing the industries and occupations where alcohol or drug use pose a potential safety problem (and is costly in terms of productivity losses) allows AOHS and AADAC to work with industry to put appropriate programs in place and address work place design attributes which contribute to the problem.
  - *Effective pesticide decontamination procedures for clothing, equipment, and spills.* Pesticide exposure should be minimized to protect workers from potential harmful health effects. Many pesticides are not removed from protective work clothing by regular washing procedures. Laundering work clothing at home is the normal practice and can put other family members at risk as the chemicals can be spread to other clothing. The research will identify practical and safe procedures to follow when laundering work clothing to protect the worker and family from potential adverse health affects of commonly used pesticides.
  - *Lung health of workers producing oriented strand board.* Forest products manufacturing is increasingly important to the Alberta economy. Workers in these plants are exposed to chemicals and wood dust which may affect the respiratory system. The findings of this study have implications for chemicals and processes common in the forest products industry, as well as in other industries.
  - *Evaluation of fire resistant work clothing.* Fire resistant work clothing is worn by workers where there is a risk of explosions or flash fires. Clothing worn under or over fire resistant work clothing effects the protection provided by the special fabrics. The effect of layering different fabrics is being studied so that industry can be advised on the combinations which would offer the best protection.

8.15 Alberta Technology, Research and Telecommunications (TRT)

(a) Background

Technology development has assumed economic importance in two distinct but mutually reinforcing senses. First, the application of advanced technologies is clearly acknowledged as a means of enhancing productivity within traditional industrial sectors. Secondly, advanced technologies offer unique potential as the basis on which entirely new industries can be developed. Viewed from this perspective, technology development can be seen as serving two fundamental economic objectives; as a means of enhancing productivity within existing industries it serves

the objective of economic growth; as the basis for the development of new industries it serves the objective of economic diversification.

The influence of advanced technologies is pervasive. The development and application of advanced technologies affects every sector of the economy: agriculture, mining, manufacturing, even finance and retail trade. Emerging technologies are shaping manpower demands and, by association, education and training programs. The influence of advanced technologies is also becoming apparent in the public policy agenda, notably in areas such as health care and the environment. Moreover, this pervasive influence is by no means unique to Alberta; technology development is truly an international phenomenon and, as such, is affecting trade patterns, foreign exchange rates, and the competitive advantage of nations.

Since its inception in 1986, TRT's primary focus has been to exploit the economic diversification and growth potential associated with advanced technologies. More specifically, the department exploits this potential by:

(1) supporting the creation and expansion of technology-intensive industrial clusters, notably in the fields of: advanced materials, biotechnology, electronics, telecommunications, environmental technologies, information technologies, and medical devices; and

(2) encouraging the application of advanced technologies in traditional resource industries and manufacturing.

The department has helped develop and build a strong infrastructure of R&D centres, research parks and business incubators to provide support for the developing advanced technology industry. Two million dollars was invested in Discovery Place One, a high technology incubator in Calgary.

The formation and support of research institutes such as the Alberta Microelectronic Centre, The LASER Institute, TRLabs and C-FER has led to the formation of core expertise on which Alberta companies can call to aid them with their technology development and application and also attract investment in Alberta by companies previously not located here. The advanced technology community in Alberta now employs over 50,000 in more than 1000 technology intensive companies.

Since 1986 over a 150 companies and organizations have been assisted through the Technology Commercialization Program. The success rate for these companies is over 95% in implementing the new technology and achieving commercial success.

(b) Department Objectives

TRT's strategic objectives are designed to strengthen the "innovation spectrum" in Alberta. The innovation spectrum is a concept which suggests that the development of technology-intensive products/processes is a cumulative process built upon basic research, applications research and development, the transfer of research results to commercial enterprises, product development, and ultimately commercialization. Practically translated, these strategies are intended to enhance provincial capabilities in:

- To support strategic basic research aimed not only at advancing the body of scientific knowledge which serves as the foundation for virtually all technology-

intensive products and services but to transfer the technology to industry.

- To support applied research and development to convert fundamental knowledge into a new or improved products and processes by assisting in bringing in the university and other research knowledge bases together with the commercial motives and efforts of industry.
- To aid in technology transfer by getting new technology into the hands of entrepreneurs and industry be it from universities, public research institutions or foreign sources.
- To assist in the development of new facilities and other supporting infrastructure requirement relevant to local industry which lie beyond the financial means of nay one individual firm.
- To assist in the expansion and or establishment of companies in technology areas relevant to the economic development and diversification of our province.
- To assist corporate venturing and aiding in forging linkages between universities, industry, and government which are necessary for optimal economic progress.
- To assist in technology adaptation aimed at increasing the application and distillation of advanced technologies in traditional industries and areas of emerging public significance.
- To support market research required for the establishment and development of companies using new technologies resulting in job creation and wealth generation.
- Through the Alberta Foundation for Nursing Research, to enhance the expertise of nurses, nursing practices and patient care.

(c) Proposed Investment Level

Preliminary budget estimates for 1993/94 are for TRT to sponsor a science and technology budget of $51.43 million, of which, $47.83 million (93%) is allocated to R&D with the remainder being RSA. It warrants emphasis that TRT is primarily a funder of R&D; only $2.8 million of the proposed $51.43 million budget represents intramural expenditures and all of this is RSA. Of the remaining $48.63 million, $47.83 million represents extramural R&D expenditures and $0.8 million represent RSA expenditures.

Technology, Research and Telecommunications will contribute $1 million in 1993/94, as part of a $4 million provincial contribution to the federal Networks of Centres of Excellence (NCE) Program. Alberta participants are involved in 12 of the 15 networks funded by the $240 million program. Alberta nodes will receive almost $20 million from the federal government over four years. Areas of research being conducted under this program in Alberta can be put into two broad categories: medical related and advanced technologies. Because of the effort made in the past to build the current research infrastructure, Alberta researchers were able to compete successfully in this national program. The NCE program alone has allowed Alberta to lever more than five times their contribution from the federal government. Industrial partners in the networks include SPI Synthetic Peptides, and Itres Research.

Alberta Foundation for Nursing Research (AFNR): AFNR provides $400,000 support for nursing research and nursing research infrastructure.

(d) Organizations Involved

TRT's science and technology budget is executed primarily by:

- the Alberta Research Council
- local industry
- research institutes.

Because its R&D agenda typically involves collaborative undertakings, the department maintains close ties with federal agencies, other Provincial departments and agencies, and, in some instances, international entities. In addition, the Minister of TRT has legislative administrative responsibility for the AHFMR, although the research agenda and funding for this agency are determined independently.

(e) Key Program Elements

1. Information Service

- Develop statistical indicators, feasibility studies and program evaluation to provide guidance in policy development and program planning
- Provide information and counsel to inventors and companies. More than 120 inventors are helped in licensing their technologies

2. Basic Research

- Support research programs at the universities as part of the National Centres of Excellence in areas such as medical research, protein engineering, space, materials, microelectronics and robotics
- Develop specialized expertise and new technology for world-wide marketing

Table 8.15.1 Program S&T Expenditures 1993/94 ($ Millions)

Program	R&D	RSA	Total	Manpower in Department
(1) Information Services	-	2.00	2.00	
(2) Basic Research	1.40	-	1.40	
(3) University/Industry Collaboration	4.10	0.75	4.85	
(4) Industry Development	5.65	0.60	5.65	
(5) Alberta Research Council	25.63	-	25.63	
(6) Other	1.90	-	1.90	
Total	38.68	3.35	42.03	14

(1) Development of statistical indicators, feasibility studies, program evaluations; (2) research devoted primarily to the advancement of science, usually undertaken by the universities; (3) primarily university/industry research centres (e.g. TRLabs, AMC, TLI, C-FER) which address an agenda ranging from precompetitive research to product improvement and provision of specialty facilities; (4) support for individual company initiatives spanning the full innovation spectrum (e.g. projects under the Technology Commercialization Fund, Westaim, etc.); (5) statutory appropriation for ARC; (6) typically development initiatives managed by other agencies on behalf of the department (e.g. SPURT fund, uncommitted WEPA funds).

3. University/Industry Collaboration

- Support university/industry research centres (e.g. TRLabs, Alberta Microelectronic Centre, LASER Institute and C-FER) which address precompetitive research for product improvement, new technology development and support for Alberta companies

4. Industry Development

- Support individual company research and development initiatives in areas of telecommunications, electronics/ microelectronics, medical and biological science, medical devices, information technology, advanced materials and processes and manufacturing technologies. These projects are often jointly funded with federal departments and agencies, and industry. The purpose is to develop new and competitive high technology enterprises in the province that will enhance and diversify the economy.

(f) Expected impact

Success in TRT's funding endeavours will ultimately be indicated by

- an increase in the number of technology intensive companies in the province
- an increase in the size of such companies in terms of revenue, employment, investment, exports, etc.
- an increase in the aggregate size of these companies relative to the economy as a whole and
- an increase in the utilization of state-of-the-art technologies in traditional economic sectors.

More immediate indicators of success will have to be adduced from indirect evidence

- increases in the province's science capabilities
- increased industrial R&D funding, and individual project fulfilment.

Table 8.15.2 Program Funding 93/94 ($ Millions)

	TRT	Federal	Industry
Western Economic Partnership Agreement(WEPA) — Telecommunications	1.25	1.05	2.30+
National Centres of Excellence	1.00	5.00	
Foundation for Nursing Research	0.40		
TechnologyCommercialization	1.25	1.25	3.00+
International Technology Transfer/ International Exchange	0.20	0.20	
WestAIM	7.20	7.30	14.80
Industry Development	1.50		2.00+
Research Institute Support	3.60		
Alberta Research Council	25.63		29.70
Total	42.03	14.8	51.80+

8.16 Alberta Transportation and Utilities

(a) Background

Alberta has an exceptionally well developed transportation system, including 13,000 km of primary highways, 15,000 km of secondary highways and 125,000 km of local roads. Responsibility for the management of this system resides with Alberta Transportation and Utilities (AT&U), through six regional offices and fifteen districts, strategically located throughout the province. AT&U has a stronger operational function than most Alberta Government departments, and this is reflected in the close ties between its research and operational activities. Alberta's economy is highly dependent on its transportation system, which is accentuated by the long distance to major markets. The value of goods moved over the system is estimated to be $28 billion annually. The tourism industry, with annual revenues of $3 billion, also depends heavily on effective, efficient transportation.

Research has impacted operational activities and produced considerable cost benefits, some examples are:

- Recycling of asphalt pavements is now done on a routine basis with an estimated saving of $2,000,000 per year.
- Development and testing of improved cracksealers for asphalt highways have a potential for reducing the frequency of cracksealing operations from annually to every three or four years with associated savings of $2,500,000 annually.
- Development and implementation of six expert systems to make highway and bridge design more efficient with a potential saving to the department of $1,000,000 annually.
- Development of two vehicles for collection of road inventory and pavement condition, which have greatly enhanced the decision making process in pavement rehabilitation, design and programming. Savings are hard to quantify, but are substantial.
- Research into bridge maintenance and construction materials (sealers, overlays, silica fume, superplasticizers, etc.) has resulted in increased bridge service life and reduced maintenance and construction costs. Benefits estimated at some $4,000,000 per year.

(b) Department Objectives

- Enhance departmental capability and use of internal resources — through effective teamwork and internal communication, business and human resource plans, effective planning cycles and processes, staff development and career planning, implementation of new technologies and systems, and effective land management.
- Protect the public's investment in infrastructure — through long term plans for maintenance and rehabilitation of bridges and pavements, improvement of methods and technologies for enforcement of regulations.
- Improve the department's effectiveness in meeting public needs — through ensuring effective partnerships, continued paving of the secondary highway systems within budget limitations, effective planning, programming and priority setting ensuring infrastructure financing and review of program and policy effectiveness.
- Meet the changing public/client needs and priorities — through ensuring an

understanding of their needs, the development and implementation of highway safety initiatives, striving for implementation of barrier-free transportation, supporting Alberta's economic priorities, involvement in environmental initiatives through effective policies, planning, design and research and development.

- Encourage an efficient integrated multi-modal system — through revision to the Alberta Railway Act and development of safety programs for provincial railways, preparation and submission of impact to national policy initiatives to facilitate the development of multi-modal transportation systems which meet Alberta's needs.

(c) Proposed Investment Level

AT&U proposed to invest $8.38 million in R&D and RSA in 1992/93, on projects contributing to the above objectives. As a result of the budget restraint initiated in November, 1991, the total R&D and RSA expenditures for 1991/92 dropped from $9.04 to $6.86 million. This new level of funding is expected to have an effect on the 1993/94 budget.

Intramural activities will represent 77.5% of the total, reflecting the direct operational role of the department.

Approximately three-quarters of the total will be invested in related scientific activities, consistent with the detailed technical surveys

Table 8.16.1

	92/93 Estimated		93/94 Proposed	
	R&D	RSA	R&D	RSA
	($ Million)		($ Million)	
Design, Operation & Maintenance of Transportation System	1.419	0.161	1.419	0.161
Bridge Engineering	-	0.050	-	0.050
Design Engineering	0.129	-	0.129	-
Roadway Planning	-	1.089	-	1.089
Materials Engineering	0.150	1.311	0.150	1.311
Urban Transportation	0.186	-	0.186	-
Environmental Impact Studies	-	0.660	-	0.660
Traffic Volume Analysis	-	1.805	-	1.805
Analyses of Highway Use & Safety (Social Science & Humanities)	-	1.417	-	1.417
Subtotal	1.884	6.493	1.884	6.493
Grand Total	8.377			8.377

required as a prerequisite to support field and operational initiatives.

Impact of Reduced Budget

Negative impacts to the department's reduced budget have the greatest effects on RSA budgets in terms of actual dollars.

There is no particular problem with re-capitalization. Fixed assets are budgeted each year for specific upcoming research projects. The systems that are developed from these fixed assets are for departmental clients. When the system is completed it is handed over to the client who assumes operational and maintenance responsibilities. When the system wears out fixed asset funds are allotted again to develop a second or third generation system for that client, or if available the client may purchase an off-the-shelf system. Non-research project data processing resources used in the administration support of research run in the order of $15,000 per year and are budgeted for through the AT&U EDP Plan annually.

(d) Organizations Involved

R&D and RSA undertaken by the department are carried out by field and operational staff to the fullest extent possible, to ensure rapid and effective technology utilization. Certain longer term projects are done co-operatively with the Alberta Research Council and the Alberta universities, making effective use of expertise and equipment in these two organizations.

The department actively pursues and contributes financially and technically to co-operative research programs, interprovincially, nationally, and internationally, where it can lever up its investment in research.

Approximately 90 department staff will be involved in these R&D and RSA activities and it is estimated that up to 20 people outside the department will be supported by this investment.

(e) Key Program Elements

1. Improvement in the design, maintenance and operation of the transportation physical plant (highways, roads, bridges, airports)

93/94 Investment	R&D ($ Million)	RSA	Total
	$1.419	$0.161	$1.580

a) Internal Component — $0.649 million

- Completion of 29 projects directly related to the construction, maintenance and operating efficiency of road surfaces and bridge decks (e.g. field evaluation of new crackfilling material).
- initiation of 10 new projects focused on new materials for the construction and maintenance of the highway system (e.g. replacement of lead-based bridge paints with non-toxic coatings)
- roadway engineering R&D
- technology transfer

Each of these activities will ensure maximum safety and convenience to the motoring public, with a better, safer, and more efficient roadway system.

b) Extramural component — $0.770 million

- Co-operative R&D with the Alberta Research Council and universities. Improved performance of pavements, bridge structures and hydraulics.
- Participation in national and international R&D

- Participation in the U.S.A. Strategic Highway Research Program (SHRP), and the associated Canadian C-SHRP program, provides access to major advanced transportation research programs, investigating asphalts, pavements, concrete structures and highway maintenance operations.
- Participation in Forest Engineering Research Institute of Canada (FERIC) provides research into improved stability of log haul trucks used extensively in BC and Alberta.
- Participation with Research Development Council (RDC) provides access to research conducted into roads, infrastructure and environmental matters of national importance.
- Research into recycled tires for use in asphalt pavements could have significant environmental impact in the future.

These programs will ensure that our roadway system meets acceptable standards at minimal cost and provides the best roadway system under the environmental conditions experienced in the province.

Reduced Budget Impact:

Will directly affect the effort that can be directed towards roads, bridges and the infrastructure, use of better processes, techniques and high technology to increase productivity, develop longer lasting materials, and decrease maintenance costs and reduce rehabilitation needs. Co-operative research (extramural) would also suffer. The long term effect would be costs to AT&U of millions of dollars annually.

2. Roadway Planning (to provide the technical information needed to design the Alberta highway system)

- almost entirely technical surveys of existing and proposed highway infrastructure, including long range planning for right-of-way requirements. An expansion in EDP facilities is needed to improve data processing. This program will provide systemic selection of highway routes, to maximize design and construction benefit/costs.

Reduced Budget Impact:

Would be forced to concentrate on only production level activities instead of searching for highly innovative and productivity enhancing technologies.

3. Materials Engineering

- a modest sum is spent on materials research, however the majority is for quality control and technical surveys for pavement structural design, and assessing conditions for performance and possible rehabilitation to ensure lasting and acceptable pavement performance.

Reduced Budget Impact:

Will delay new technology implementation in paving materials. Quality of data gathering will be reduced in monitoring highway system performance. Effects will be to produce less cost effective programming and design decision making, which in the long run will necessitate increased capital spending to offset deteriorating infrastructure.

4. Urban Transportation

- involves co-funded R&D projects with 12 Alberta cities to provide better, safer and more efficient urban transportation systems.

Reduced Budget Impact:

Grant reduction will/has resulted in municipalities concentrating the funds on capital projects. In other words, R&D is low priority and the first activity to be discretionary. In the long term this becomes a cost to AT&U since we provide the grants.

5. Environmental Impact Studies

- involves special projects to assess the environmental impact of the highway system to protect historical and biophysical resources. This activity requires additional funding and resources for the future.

Reduced Budget Impact:

Archaeological — would not be able to do impact studies required to get clearance from Culture to either build roads or excavate gravel pits — resulting in road not being built or delayed.

Environmental — would not be able to meet Environment's impact assessment requirements — resulting in decrease in co-operation between departments. Possible increase in charges by Forestry, Lands and Wildlife and overall frustration of the road construction process in sensitive areas.

6. Traffic Volume Analyses

- primarily technical acquisition of the traffic volume reports needed to design and improve the highway system due to increasing traffic volumes. Upgrades in data processing facilities are needed to improve effectiveness of data retrieval and use.

Reduced Budget Impact:

Will collect less data and not develop as sophisticated modelling system. This would reduce the accuracy of the model, and increase the aggregate error. Many other branches of AT&U depend on this data for their decision making, especially for urban, fringe related construction and mega project construction. In the long term, the cost to AT&U could be in the order of a few millions dollars per year.

7. Analyses of Highway Use and Safety

- primarily technical surveys related to transportation safety, accident analysis, and infrastructure damage assessment to improve highway safety, protect against potential liability claims, and provide convenience to the motoring public.

Reduced Budget Impact:

Would be greatest on the manpower component. This would cut down the speed of technology diffusion/transfer in analysis related operations. Short term (i.e., one to two years) effects could be absorbed, but long term (i.e., four years onward) would adversely affect productivity. A 10% reduction would result in a 2% — 3% production loss per year. This would be accumulative over time.

8. Bridge Engineering

- involves surveys to determine scour in river beds to maintain bridge structure integrity to ensure public safety.

Reduced Budget Impact:

Would jeopardize the safety of some bridges on major highways. Would reduce the amount of data that is collected, which in turn would affect the quality of the trend analysis which is used to base design changes, which could result in a quantitative long term cost to AT&U of one or two failures of major bridges on secondary or primary highways per year.

Table 8.16.2 Co-operative Research Funding 1992/93 (R&D)

Project/ Program	FUNDING ($) AT&U	Alberta Govt./ Local Govts.	Other Provincial	Federal Government	International	Industry	Total
SHRP/C-SHRP	75,000	–/–	1,005,000	120,000	30,000,000	–	31,200,000
ARC	302,000	302,000/–	–	–	–	–	604,000
FERIC	20,000	10,000/–	20,000	537,150	–	129,000	716,150
RDC	23,000	–/–	225,500	186,500	–	–	435,000
Recycled Tires in Asphalt Pavement	55,000	–/30,000	–	–	–	15,000	100,000
Total	475,000	312,000/30,000	1,250,500	843,650	30,000,000	144,000	33,055,150

SHRP: United States Strategic Highway Research Program

C-SHRP: Canadian Strategic Highway Research Program

ARC: Alberta Research Council

FERIC: Forest Engineering Research Institute of Canada

RDC: Research & Development Council of the Transportation Association of Canada

Most of the research programs shown are of more than one year duration, the table depicts a snapshot in time, e.g., SHRP/C-SHRP are five year research programs whose total value is $156,000,000. Similar co-operative scenarios may be expected in 1993/94 and beyond.

For an investment of $475,000, Alberta Transportation and Utilities gains access to $35,055,150 of research in a given year — leverage ratio of 70:1.

Appendix 1 Participants in The Research Overview Study

A. Deputy Ministers' Committee on Research and Policy

Mr. H.M. Alton, Deputy Minister, Transportation & Utilities

Dr. Brian Barge, President, Alberta Research Council

Mr. Ken H.G. Broadfoot, Deputy Minister, Technology, Research & Telecommunications

Ms. G.L. Duncan, Deputy Minister, Advanced Education

Mr. M.F. Kanik, Deputy Minister, Energy

Mr. Rheal J. LeBlanc, Deputy Minister, Health

Mr. Vance MacNichol, Deputy Minister, Environment

Mr. H.G. McEwen, Deputy Minister, Agriculture

Mr. J.S. O'Neill, Deputy Minister, Culture and Multiculturalism

Mr. C.B. Smith, Deputy Minister, Forestry Lands & Wildlife

Dr. Matthew Spence, President, Alberta Heritage Foundation for Medical Research

Dr. H. Walker, Managing Director, Occupational Health & Safety

Mr. W.J. Yurko, Chairman & Chief Executive Officer, Alberta Oilsands Technology & Research Authority

B. Technology and Research Advisory Committee

* Dr. Brian Barge, President, Alberta Research Council

Mr. Jay Bell, Associate Director, Federal & Intergovernmental Affairs

Mr. J.A. Brennan, Executive Officer, Forestry, Lands & Wildlife

Dr. R.G. Christian, Executive Director, Agriculture

Mr. C.L. Dmytruk, Senior Director, Economic Development & Trade

Dr. R. Fessenden, Vice-President, Alberta Research Council

Mr. J.K. Kleta, Executive Director, Energy

Ms. Cecilie Lord, Assistant Deputy Minister, Alberta Health

Mr. Dennis Lyon, Director, Occupational Health & Safety

Mr. K. Murricane, Assistant Deputy Minister, Technology, Research & Telecommunications

* Dr. C. Reichert, Senior Director, Science Advisory, Technology, Research & Telecommunications

Dr. Matthew Spence, President, Alberta Heritage Foundation for Medical Research

* Dr. A. Vanterpool, Secretary, Premier's Council on Science & Technology

Dr. R.S. Weaver, Assistant Deputy Minister, Alberta Environmental Centre

Dr. W.L. Workman, Assistant Deputy Minister, Advanced Education

Mr. W.J. Yurko, Chairman/CEO, Alberta Oil Sands Technology & Research Authority

* Research Overview Task Group

Appendix 2 Progress on Implementation of Recommendations of Research Co-ordination Report

A. Comprehensive Science And Technology Policy

1.1 The Government should endeavour to maintain the current level of research investment, ensuring it is not progressively eroded by inflation. A Provincial Science and Technology Policy should be developed to provide guidance to future research strategy and investments, and to provide a sharper focus on priorities.

The Premier's Council on Science and Technology has prepared a draft vision and policy statement as a preliminary step to producing a long term strategy for the province in science and technology. Meetings are currently being held with about 30 focus groups in an effort to further develop a vision and policy which is shared by the majority of the science and technology community.

1.4 Government Departments/Agencies should maximize their efforts to obtain upward leverage on their research investment by seeking complementary support to their own efforts from industry, other levels of government, and academia.

A study is being conducted by Mr. Len Bolger on behalf of TRT as a follow-up to the Research Overview, which will concentrate on R&D in the private sector. The purpose is to identify the perceptions in the private sector of the importance of R&D and the factors that may inhibit or limit R&D. The study will to some extent examine current levels of R&D performed in the private sector and identify options to encourage more R&D investment. The Technology and Research Advisory Committee (TRAC) is also examining what appropriate working arrangements the various Government departments and agencies should have or develop with their respective industry sectors to stimulate more R&D investment.

1.2 When financial conditions permit, the Government should increase its research investment to the somewhat higher level of the mid-1980's bolstering relatively weaker areas such as research in health services and the environment.

On April 1, 1992, Alberta Health established a $1 million Health Services Research and Innovation Fund. It is in the process of establishing the Provincial Advisory Committee on Health Research to report to and provide advice to the Minister of Health. The committee will consist of people with broad expertise who will provide guidance regarding the approach, priorities and policies for Health Services Research in Alberta.

1.3 Over the longer term, Alberta should move its research investment closer to an internationally competitive level.

Phase 3 — under active examination.

B. Technology And Research Advisory Committee And Research Planning

4.3 The mandate and membership of TRAC should be amended and enlarged to address issues that cut across several departments and agencies; examples include health care research, energy research, industrial/commercial research, environment research, and international science and technology agreements.

TRAC as an interdepartmental and agency committee, reviewed its role in advising the Alberta Government and its departments in the areas of research, science, technology and related policy areas. It identified several areas requiring increased emphasis.

1. To proactively review, provide comments and develop positions on policies relating to science and technology as they relate to economic and social development.
2. To serve all departments and agencies as a truly interdepartmental committee.
3. To develop closer linkages with the deputy ministers of the departments represented on the committee.
4. To focus greater attention on issues that may impact science and technology policy and program implementation as related to the social and economic development and well being of the province.

Alberta Health was added to the membership of TRAC and a standing committee was established chaired by the Assistant Deputy Minister, Policy & Planning, Alberta Health to "address the co-ordination of health care research and development issues across government departments and agencies."

4.4 The Alberta Government departments and agencies should prepare an annual compilation and analysis of their total research investment plans. The consolidation of these plans should be undertaken by TRAC.

In 1991, TRAC prepared the first ever overview of the total Alberta Government research program. A committee chaired by TRT including Alberta Energy, Alberta Agriculture, and Alberta Environment was responsible for co-ordinating the preparation of the Research Overview with the purpose of:

1. Describing and analyzing the 1992/93 science and technology investment.
2. Identifying the impact that Alberta's past science and technology investments have played in the economic and social health of Alberta.
3. Identifying impact of current and future investments.

The recommendations made in the report are:

1. The Alberta Government should make technology-based industrial competitiveness a major goal for this decade.
2. The Alberta Government should increase its investment in research to $300 million/year, the minimum needed to restore research activities to the mid 1980 level.
3. The Alberta Government should put top priority on programs to substantially increase industrial commitment to R&D.

3.3 Recognizing the multi-year nature of many research projects, departments and agencies should ensure that future financial requirements are incorporated into their long-term plan. For major government research programs, approval in principle should be sought through RFDs.

Many of the departments are currently making efforts to address this issue. Alberta Agriculture prepared a detailed three year plan for the department and the Agricultural Research Institute with an RFD for the funding of the program. Alberta Energy prepared

detailed strategic plans for each of its Coal, Hydrogen, Renewable Energy and Mineral Development Programs that were presented to TRAC for review.

The Alberta Research Council prepared a corporate plan "A Vision to the Year 2000" with extensive input from its stakeholders in Government and the private sector.

C. Systemic Issues

5.1 The following issues, common to many Government departments and agencies, should be resolved: — replacement of aging and obsolete equipment, — compression of salaries for senior engineers, scientists, and other technical specialists, — replacement of special purpose funds when the funds are expended, — handling intellectual property.

TRAC has set up a subcommittee, chaired by Alberta Environment with members from Premier's Council on Science and Technology, ARC and Agriculture, to review the issues.

The subcommittee has identified capital equipment replacement costs in Alberta's research facilities in the order of $36 million. It has examined the difficulties departments encounter in funding large equipment purchases and is preparing a report with recommendations. It is also examining the issue of intellectual property and are formulating recommendations.

D. Rationalize Status And Operational Aspects Of Alberta Environmental Centre And Other Government Science And Technology Organizations

2.1 Serious consideration should be given to the establishment of the Alberta Environmental Centre as a "Crown corporation" (like the Alberta Research Council), so its services can be provided on a business basis, with appropriate accountability to Alberta Environment and other clients.

Project Synergy was initiated to study the options for the Alberta Environmental Centre (AEC). A report on Project Synergy was prepared by senior officials from AEC and ARC which identified four options with the preferred recommendation being the option which would see the two agencies become a single entity. A draft proposal is being reviewed by senior management

2.2 The smaller specialized research facilities within Government departments should be permitted to receive funds for research and development to serve the needs of both Government and the private sector. One method to accomplish this would be to have one of the provincial "Crown corporations" serve as a banker for this purpose. Another approach would be to establish an Alberta Research Trust to accept grants, contracts, endowments, etc., for the purpose of carrying out research in various Government laboratories.

Several research facilities already receive some outside funding for doing research. Discussions are ongoing, examining the process to make the system more effective.

2.5 The chief executive officers of the many autonomous research institutes having their own governing boards, which are funded in part by the Alberta Government, should meet to determine if efficiencies can be gained through a higher level of collaboration, for example, in the provision of research support services.

An interim Organizing Committee consisting of ARC, AEC, TRLabs and C-FER was set up to examine institute collaboration. The first area addressed is to develop a co-operative proactive communications program to increase the understanding and appreciation of decision makers, in both the public and private sectors, about the importance and value of research and technology to the province. Some activities planned or underway to achieve this objective are:

1. Media luncheons with overviews of research activities, and tours of research facilities.
2. Open house for members of the Legislative Assembly.
3. News letters and feature stories on member organization activities.
4. Other activities such as symposia, advertising on radio and television and television documentaries.

Other areas for co-operation are under discussion.

2.3 The research facilities that are under the direct control of the Government should seek efficiencies through co-operation in the provision of research support services (computing, library services, human resources, training, handling intellectual property, analytical services, safety, etc.)

The Organizing Committee described under 2.5 is also looking at possible areas for co-operation, specifically in research support services.

E. Interface Issues

4.1 The following departments and agencies should address issues in the planning, co-ordination, and execution of research in the specified areas:

- **Alberta Environment and Alberta Forestry, Lands and Wildlife should develop a long-term joint environmental research strategy to meet the environmental targets of the forest, lands, and wildlife sectors.**

Forestry, Lands and Wildlife (FL&W) indicated that development of a long term environmental research strategy to meet the environmental targets of forest, lands and wildlife sectors will be facilitated under the structure recommended by Project Synergy for the Alberta Environmental Centre. FL&W already conducts many projects jointly with ARC.A new joint program for R&D in forestry was signed with the federal government under the Western Economic Partnership Agreement (WEPA). An interdepartmental committee was formed to administer the program.

- **Alberta Energy, Alberta Environment and AOSTRA should develop a long-term joint environmental research strategy in the energy area and ensure their current portfolio of programs fits that strategy.**

The Alberta Energy strategic plan in Coal R&D was developed with close co-operation of ARC, AOSTRA and industry and was reviewed by TRAC and the departments and agencies they represent. Alberta Energy is working with the departments and agencies to assess R&D priorities and to develop closer co-ordination. The AOSTRA proposal on an Alberta Centre for Upgrading Technology was reviewed by TRAC and the departments and agencies they represent.

- **Alberta Health, Alberta Occupational Health and Safety, Alberta Heritage Foundation for Medical Research, hospitals, medical schools, public health boards, Alberta Cancer Board, Alberta Foundation for Nursing Research, and other health care stakeholders should develop a research strategy to better balance the research efforts between health services research and basic medical research.**

A standing subcommittee of TRAC chaired by the Assistant Deputy Minister, Policy and Planning, Alberta Health, was established to address research policies relating to health issues and technology development, including health research funding and specifically to address the co-ordination of health care research and development issues across government departments and agencies. The following departments and agencies are represented on the committee:- Alberta Health — Alberta Family Life and Substance Abuse Foundation — Advanced Education — TRT — Alberta Research Council — AFNR — AHFMR — Alberta Agriculture — Alberta Environment — Alberta Cancer Board

Alberta Health is establishing a Provincial Advisory Committee on Health Research (PACHR) with broad representation from the health community to provide input on principles on health services and research, develop priorities and facilitate effective communication and collaboration.

- **Alberta Economic Development and Trade and Alberta Technology, Research and Telecommunications should better co-ordinate support for the growing sector of manufacturing which is not tied directly to the resource industries.**

Both departments are working to ensure improved co-ordination in support to the manufacturing sector. ED&T is developing a manufacturing strategy and has established an interdepartmental committee of which TRT is a member.

- **Alberta Advanced Education and Alberta Technology, Research and Telecommunications should better co-ordinate the Government's policies and programs related to support for basic research.**

TRT and Advanced Education have co-operated in this area for some time. The issues have been outlined and work is well underway. A report is expected this summer.

- **Alberta Federal and Intergovernmental Affairs should facilitate the preparation of an international technology strategy that is in harmony with the province's future economic objectives involving all departments and agencies having international responsibilities.**

A TRAC subcommittee prepared a report outlining existing international activities in science and technology. FIGA is chairing a TRAC subcommittee to develop an international technology policy and strategy that fits with provincial objectives.

- **Alberta Forestry, Lands and Wildlife, Alberta Economic Development and Trade and Alberta Technology, Research and Telecommunications should better co-ordinate forestry industry and forest products industry research and development programs.**

A Forest Products Research Management Committee was established with the Canadian Alberta Forest Resource Development Agreement and will continue under the new Western Economic Partnership Agreement (WEPA). The Committee will co-ordinate research activities of industry and Government. TRT is a member of this committee.

- **Alberta Culture and Multiculturalism and Alberta Forestry, Lands and Wildlife, Alberta Energy, and Alberta Transportation and Utilities should ensure that resource development decisions allow for appropriate assessment, research, and protection of the province's human and natural historical resources.**

An interdepartmental committee headed by Alberta Environment, including Alberta Culture and Multiculturalism, Alberta Forestry, Lands & Wildlife, Alberta Energy, and Alberta Transportation and Utilities, examines all resource development proposals with regard to environmental impact and protection of the Province's human and natural historical resources.

4.5 The Natural Resources Advisory Committee (NRAC) should ensure that research and technology matters which impact the development, management and conservation of land and natural resources are included in its activities.

NRAC has done a preliminary review of the recommendation. They are prepared to have a role, above the project level, to address the long term strategic needs based on broad objectives and cross sectoral analysis of issues.

4.2 Recognizing the significant investment in expertise and infrastructure provided by the Alberta Government to the Alberta Research Council, Government Departments/Agencies should endeavour to leverage their own research funds by developing collaborative research programs with the Research Council.

All the departments are endeavouring to leverage their research funds through collaboration with industry, industry association and the Federal Government.

3.1 Government departments/agencies with a significant research effort should establish a central body to guide and co-ordinate this effort and to ensure it is well integrated into the department's, and the Government's, long-term strategic plan.

Phase 3 — under active examination

3.2 The on-line management and execution of research projects should be decentralized and embedded in the ongoing operations and "culture" of Government department/agencies.

Phase 3 — under active examination

2.4 Newly emerging research technologies, which are required by a number of departments and agencies, should be developed and funded on a co-ordinated basis. Examples are spatial information technologies (geographic information systems, remote sensing, etc.) and expert systems. The Alberta Research Council, where appropriate, should take a leadership role in seeking this co-ordination.

Phase 3 — under active examination

2.6 If, in the longer term, a high level of research co-ordination is required, the Government should investigate models such as the German Fraunhofer institutes. The Fraunhofer Society uses a centralized board to oversee a number of relatively autonomous applied research institutes.

Phase 3 — under active examination

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